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Bulletin of Duke University 1973-1974

The School of Forestry

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University Administration

General Administration

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Victor A. Bubas, B.S., *Assistant to the President*
Rufus H. Powell, LL.B., *Secretary of the University*
A. Kenneth Pye, LL.M., *University Counsel*

School of Forestry Administration

Charles William Ralston, M.F., Ph.D., *Dean of the School of Forestry*
Fred Myerle White, M.F., *Director of the Duke Forest and Assistant to the Dean*
Leon Edward Chaiken, M.F., *Director of Admissions*
Roger Fabian Anderson, M.S., Ph.D., *Director of Graduate Studies in the Department of Forestry of the Graduate School*

School of Forestry Faculty and Staff

Roger Fabian Anderson (1951), M.S., Ph.D., *Professor of Forest Entomology*
Robert Lloyd Barnes (1965), M.F., Ph.D., *Professor of Forest Biochemistry*
Leon Edward Chaiken (1952), M.F., *Professor of Forest Management*
Roger C. Chapman (1969), M.F., M.S., *Assistant Professor of Biometry*
Frank J. Convery (1971), M.S., Ph.D., *Assistant Professor of Natural Resource Economics*
Ellwood Scott Harrar (1936), M.S., Ph.D., *James B. Duke Professor of Wood Science*
Henry Hellmers (1965), Ph.D., *Professor of Botany*
Frederick Charles Joerg (1947), M.B.A., *Professor of Forest Management*
Kenneth Richard Knoerr (1961), M.F., Ph.D., *Professor of Forest Meteorology*
Paul Jackson Kramer (1931), M.Sc., Ph.D., *James B. Duke Professor of Botany*
Charles William Ralston (1954), M.F., Ph.D., *Professor of Forest Soils*
William James Stambaugh (1961), M.S., Ph.D., *Professor of Forest Pathology*
Fred Myerle White (1959), M.F., *Assistant Professor of Silviculture*
David Owen Yandle (1967), M.S., Ph.D., *Associate Professor of Forest Mathematics*
James Edward Wuenscher (1970), M.S., Ph.D., *Assistant Professor of Forest Ecology*

Associate Faculty

Donald J. Fluke, Ph.D., *Professor of Zoology*
Aubrey W. Naylor, Ph.D., *Professor of Botany*

Adjunct Faculty

Edgar W. Clark, Ph.D., *Adjunct Associate Professor of Forest Entomology*
Milton S. Heath, Jr., LL.B., *Adjunct Professor of Environmental Law*
Charles S. Hodges, Jr., M.F., Ph.D., *Adjunct Associate Professor of Forest Pathology*
Louis J. Metz, M.F., Ph.D., *Adjunct Associate Professor of Forest Soils*
Fred M. Vukovich, Ph.D., *Adjunct Associate Professor of Forest Meteorology*

Staff

Patricia S. Rorie, *Recorder and Secretary to the Dean*
E. Otto Griffin, Jr., *Superintendent, Duke Forest*
Edwina Johnson, B.S. in L.S., *Librarian, Forestry-Biology Library*
Sue P. Hicks, *Secretary, Duke Forest*
Nancy A. McMannen, *Secretary*
Jo W. Russell, *Secretary*

Faculty Emeriti

James Granville Osborne, B.S., *Professor Emeritus of Forest Biometry*
Albert Edward Wackerman, M.F., *Professor Emeritus of Forest Utilization*
Frederick Adolphus Wolf, Ph.D., *James B. Duke Professor Emeritus of Botany*

School of Forestry Calendar 1973-74

1973

August	
29-31	Wednesday-Friday—Consultation with advisers for new students
September	
1	Saturday—Registration and matriculation for all students who have not preregistered in the School of Forestry
4	Tuesday—Fall semester classes begin
November	
21-23	Wednesday-Friday—Thanksgiving Break
26	Monday—Classes resume
December	
11	Tuesday—Fall semester classes end
14	Friday—Final examinations begin
21	Friday—Final examinations end

1974

January	
10-11	Consultation with advisers for new students
12	Saturday—Registration and matriculation for all students who have not preregistered in the School of Forestry
14	Monday—Spring semester classes begin
March	
18-22	Spring Break—Spring Field Trips
April	
26	Friday—Spring semester classes end
30	Tuesday—Final examinations begin
May	
7	Tuesday—Final examinations end
12	Sunday—Baccalaureate and Commencement

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TRIANGLE UNIVERSITIES
RESEARCH PROJECT
ENTRANCE RESTRICTED
INQUIRE AT TRAILER
FOREST
RESEARCH
EXPERIMENTAL PLOT

1

General Information

Duke and the School of Forestry

Duke University, located at Durham, North Carolina, comprises Trinity College of Arts and Sciences, the School of Engineering, the Graduate School, and the professional schools of Forestry, Divinity, Law, Medicine, Business Administration, and Nursing. The University dates from 1838, when Union Institute was founded in Randolph County by the Methodists and Friends. In 1851 the institution became Normal College, one of the first schools in America for the training of teachers. In 1859 the name was changed to Trinity College and so continued until 1924, when the College became a part of Duke University.

By virtue of an indenture of trust, executed December 11, 1924, by James Buchanan Duke, there was a great benefaction, providing for hospitalization, church work in rural communities, and education. The principal feature of the educational provision was the creation of Duke University.

The University, with a student body totaling 8,000, occupies two campuses. The East Campus of 108 acres was formerly the campus of Trinity College. About a mile west are the newer units of the University, known as the West Campus, totaling 467 acres. It was first occupied in September, 1930.

Forestry at Duke University began early in 1931 when the Duke Forest was placed under intensive forest management and forestry research was initiated. An academic-forestry curriculum, designed for men and women intent upon pursuing the study of forestry as a profession, was organized in Trinity College of Duke University in 1932. This program was enlarged in 1952 and now includes more than sixty cooperating colleges and universities. (See pages 16-17.)

In 1938 the School of Forestry was organized at the graduate level and a curriculum was offered leading to the degree of Master of Forestry. Work leading to the degree of Doctor of Forestry has been offered since 1940. The School has been fully accredited since its origin. A degree in forestry at the undergraduate level is not offered at Duke University.

Graduates of recognized colleges and universities, professional schools of forestry, and other students who meet the entrance requirements of the School (see page 19), may enroll in forestry programs leading to the professional degrees —Master of Forestry and Doctor of Forestry. The Department of Forestry in the Graduate School also offers graduate work in certain aspects of forestry leading to the degrees of Master of Science and Doctor of Philosophy. This work is available to graduates of schools of forestry of recognized standing, and to college or university graduates holding a bachelor's degree. All applicants will be considered without regard to race, color, religion, sex, or national origin.

2

Program Information

Related Fields

Basic scientific or professional programs of study are available in the following fields of forestry and related natural resources. Interdisciplinary programs between fields within the School of Forestry and those in other departments of the University also are possible and strongly encouraged.

Biological Science

Forest Ecology
Tree Physiology and Biochemistry
Forest Pathology
Forest Entomology
Dendrology and Wood Anatomy

Environmental Science

Forest Soils
Forest Meteorology and Biometeorology
Wildland Hydrology

Statistics and Operations Research

Biometry and Statistics
Mensuration
Operations Research

Economics and Management

Natural Resources Economics and Policy
Forest Management

With exception of forest management, study in all of the above fields can be pursued in programs for a M.S., A.M., or Ph.D. degree in the Department of Forestry of the Graduate School, or in a professional program for a M.F. or D.F. degree from the School of Forestry. Work in forest management is in professional M.F. and D.F. degree programs of the School of Forestry. Students contemplating careers in teaching and research are strongly urged to follow courses of study in the Department of Forestry in the Graduate School.

In addition, the following special management or business-oriented programs of study leading to the M.F. degree are available in the School of Forestry: Post Liberal Arts and Science Program, Business Management Program, Forest Protection Program, Cooperative Forestry Program, and Natural Resource Ecology and Environmental Management Program.

Detailed information on these special programs is given under the Master of Forestry Degree and the Cooperative Plan of Study sections in this *Bulletin.*

Courses available in the various fields of forestry and related natural resources are indicated in a later section of this *Bulletin.*

Master of Forestry Degree

The requirements for the degree Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education, both in professional and related subjects, and by his specific career objectives. Normally, students who have earned the degree of Bachelor of Science in Forestry, or the equivalent, from an accredited school of forestry, may complete the requirements for the M.F. degree in one academic year. Depending on prior preparation and the field in which he desires to concentrate, a student without previous education in forestry will be required to complete the equivalent of either four or five semesters of resident study. Graduate work of equivalent grade done in residence at other institutions may, with the approval of the faculty, be accepted as credit toward the degree, but a minimum of one year of residence at Duke University is required.

The submission of a thesis for the M.F. degree may be required. With the approval of the faculty, an acceptable report on a special study may be submitted in lieu of a thesis, credit for which will not exceed three units. Four copies of the thesis, typewritten and bound in accordance with regulations set forth by the faculty, must be deposited with the dean of the School of Forestry on or before April 15 of the academic year in which the student expects to obtain the M.F. degree.

A student who has not completed his thesis while in residence must submit an acceptable manuscript to the faculty within a period of two years following the termination of his residence.

No student may take less than 14 nor more than 18 units of credit per semester without special permission of the faculty (see page 24.)

Post-Liberal Arts and Science Program. Men and women who are college graduates but have had no prior professional forestry training may be admitted to programs of study leading to the degree of Master of Forestry. Depending on the program of study, 60 to 70 units of credit in residence are minimal requirements, including the core courses listed below. In the case of students with advanced preparation relevant to their specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on individual bases and only with specific recommendation of the student's major program adviser and approval by the faculty.

Core courses normally are completed during the first year of residence. However, students lacking prerequisites for specific courses may postpone such courses until the prerequisites have been completed.

Core Courses

	Units
Tree Growth and Development (For. 205)	3
Soils and Forest Resources (For. 261)	3
Resource Economics and Policy (For. 269)	3
Forest Ecology (For. 243)	3
Dendrology (For. 241)	3
Careers in Natural Resources (For. 200)	0

During the latter part of the first year, each student will be requested to designate the field (or fields) he wishes to pursue for a major. After the student has designated his field of interest, he will be assigned a faculty adviser who, in consultation with the student, will develop a program of study in a manner similar to that described under the Post-Professional Program (see below).

Any student who does not earn a grade of *E* or *G* in at least six units of work in the first academic year will not be permitted to enter into the work of the second year.

Post-Professional Program. Students with satisfactory undergraduate professional training qualify for advanced study and research in the various disciplines of forestry under this program. A specific study plan is developed for each student through consultation with a faculty advisory committee. For the student planning a managerial career in the general area of forest production (and where the Master of Forestry is planned as a terminal degree), his program of study usually consists of courses and seminars, with a major portion of the work concentrated in the area of the student's interests. For the student with research interest, the study plan is oriented within the subject matter field of interest toward the furtherance of a research career, or toward preparing him for academic training beyond the master's level.

A number of courses offered in other departments of the University are open to qualified students in the School of Forestry. One or more of these may be included in a student's study plan when considered advisable by his advisory committee.

A minimum of 30 units, in which the student must earn a grade of *E* or *G* in at least 6 units, are required for the degree of Master of Forestry, under this program. Normally, 15 units of credit (including the thesis) must be earned in the School of Forestry.

Business Management Program. A specialized program is offered in the School of Forestry in cooperation with the Department of Economics to prepare

forestry graduates for managerial careers in the business aspects of industrial forest land management or forest products. The program requires two years of study and training leading to the degree of Master of Forestry. It is open to selected students who have earned a bachelor's degree (or the equivalent) in general forestry, forest management, forest utilization, or wood science and technology, with the proper prerequisites, and who also have potential leadership qualities indicative of administrative and executive capacity.

The general requirements of the program are as follows:

1. At least 10 courses (30 units) in economics and business administration or in closely allied fields.
2. Approximately 5 courses (15 units) in forestry which deal with principles of administration and decision-making.
3. Experience as a paid managerial trainee with a cooperating firm for a period including the fall semester of the second year and the preceding summer.
4. A written analysis of some phase of the managerial operation of the organization with which the training period is spent.

A specific program of study, commensurate with each student's academic background and future goals, will be developed by the program advisory committee in consultation with the student. A sample list of suggested courses included in such a program of study is available upon request.

Students entering the program must meet the admission requirements of the School of Forestry and be approved by a committee representing the faculties of Economics and Forestry. The financial award benefits of the School of Forestry are available to applicants for this program (see pages 39-40). Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry upon request.

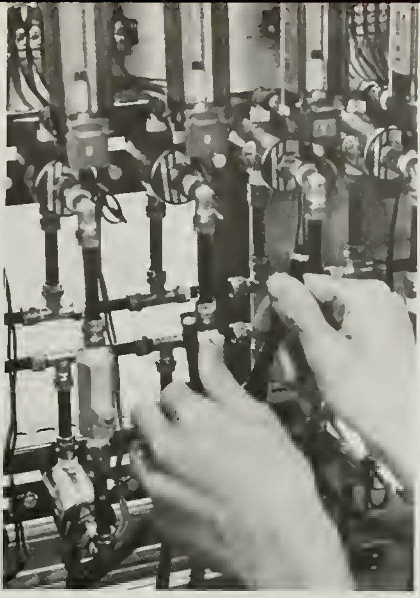
Forest Protection Program. A combined program of specialization in entomology-pathology is available for students desiring career preparation in the applied aspects of forest insect and disease control. This program of study leads to the Master of Forestry degree. Students clecting the program must hold either a bachelor's degree in general forestry or have equivalent preparation in the biological sciences.

The general requirements of the program are as follows:

1. A minimum of 28 units in forest entomology and forest pathology. With approval, credits in closely related disciplines may be substituted.
2. At least 12 units of courses and seminars dealing with managerial and statistical aspects of forest protection.
3. One summer of employment experience with a forest protection agency.
4. Organization, conduct, and report of applied research on a forest insect and/or disease problems (4 units).

Reasonable latitude will be permitted in selecting courses to accommodate specific needs and interests. Each program of study will be developed in consultation with the program directors. A list of recommended courses is available upon request.

Applicants for this program must meet the requirements of the School of Forestry and the approval of the program advisory committee. Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry.



Natural Resource Ecology and Environmental Management Program. A professional program is offered to students with career interests in the expanding fields of environmental management and protection. The basic objective of this program is to develop expertise in planning and administering the management of natural resources and the non-urban environment for maximum human benefits with minimum deterioration of ecosystem stability. Emphasis is placed on the ecosystem as the basic unit of natural resource management.

This program of study leads to the Master of Forestry degree and is open to students with a bachelor's degree in biological or environmental science or with training in other fields but strong motivation toward an ecological approach to natural resource problems.

General requirements of the program are:

1. A minimum of 24 units in resource ecology and environmental science.
2. At least 9 units of courses dealing with statistical or mathematical analysis of natural resource problems.
3. A minimum of 15 units of courses in resource use planning, business, and public administration.

4. Formulation, analysis, and report of research on an applied problem related to ecological or environmental aspects of natural resource management.

Although all students are expected to have substantive knowledge of principles of resource ecology, environmental science, and quantitative analysis, reasonable latitude is permitted in electing courses to meet the interests and capabilities of individual students. Each program of study will be developed in consultation with the program directors.

Application forms for admission and financial aid may be obtained from the director of admissions of the School of Forestry.

Program in Tropical Forestry. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in the *Graduate School Bulletin* in the chapter Special and Cooperative Programs.

Master of Science Degree

Prerequisites. The degree of Master of Science (M.S.) is offered through the Department of Forestry in the Graduate School. As a prerequisite to this degree a student must have earned a baccalaureate degree from an accredited college or university. There is no foreign language requirement for this degree.

Major and Minor Subjects. The work for the Master of Science degree is designed to provide a basic foundation in a fundamental area of forestry or in a field closely allied with forestry. A minimum of 30 units of credit is required for the degree; 24 units must be in formal courses although not more than 6 units can be earned for the thesis. Specific course requirements call for a minimum of 12 units in a major field of specialization and 6 units in a minor area of concentration. The major and minor fields are determined without regard to departmental divisions of the University, if the interdisciplinary nature of the area of specialization makes such a program of study advisable. The specific program of study is developed by the major professor (thesis supervisor), subject to the approval of the director of graduate studies in forestry and the dean of the Graduate School.

The Thesis. At least one month before presenting the thesis, that is on or before February 1 for a May degree or on or before August 1 for a September degree, the student must file with the dean of the Graduate School, on the official form, the title of the thesis and the declaration of intention to graduate. The title must have the approval of the thesis supervisor and the director of graduate studies in the major department. If the student has met the degree requirements before the above deadlines, he must file his intention to graduate one month before the thesis is presented.

All basic requirements for preparing the thesis are described in the *Manual of Style for Theses and Dissertations*, revised 1961, obtainable at the Duke University Book Store, West Campus. The quality of paper, form, and binding are prescribed in the *Manual.*

Four typewritten copies of the thesis, bound in snap binders supplied by the Library, must be submitted through the Graduate School Office to the dean of the Graduate School on or before April 15 for a May degree or on or before August

15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Three copies for the Library will be bound by the Ruzicka Bindery for a fee of $5.00 a volume. The student may request that an additional number of copies be so bound.

The Examining Committee and the Examination. The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted to take related work within the major department, the third member may represent the minor field within the department. This committee is submitted for approval to the dean of the Graduate School at least one week preceding the final examination.

The student's committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. After a thesis is approved the committee also signs all copies of the thesis, and the candidate then returns the original, the first two carbon copies, and any other copies he wishes bound by Ruzicka to the dean of the Graduate School who deposits them in the University Library.

Master of Arts Degree

The degree of Master of Arts (A.M.) is offered through the Department of Forestry in the Graduate School. As a prerequisite to admission for this program, a student must have earned a baccalaureate degree from an accredited college or university. Students interested in working toward this degree should refer to the *Bulletin of the Graduate School* for specific requirements.

Doctor of Forestry Degree

The degree of Doctor of Forestry (D.F.) is a professional and research degree conferred upon those students who have satisfactorily completed specified requirements of advanced study and research.

Work toward the D.F. degree, consisting of advanced studies in a major and a minor field, is offered with majors in the several branches of forestry. A minor may be elected in forestry or in other areas of specialized study in the University approved by the faculty of the School of Forestry. Prospective students should correspond with the director of admissions of the School of Forestry on all matters pertaining to admission to the School.

Doctor of Philosophy Degree

The Doctor of Philosophy degree (Ph.D.) is conferred through the Graduate School of Duke University. Programs of study and research for men and women working for this degree are directed by faculty members of the School of Forestry who also comprise the graduate faculty of the Department of Forestry in the Graduate School. Both major and minor programs of study are available in the following branches of forestry: forest biochemistry, forest biometry, forest meteorology, forest ecology, forest economics, forest entomology, forest hydrology, forest pathology, forest soils, forest-tree physiology, and wood science including wood anatomy, timber physics, and wood chemistry.

The Ph.D. degree is essentially a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

General Requirements for the D.F. and Ph.D. Degrees

The formal requirements, discussed in detail below, for the doctoral degrees are as follows: (1) foreign language; (2) major and related courses; (3) supervisory committee for program of study; (4) residence; (5) preliminary examination; (6) dissertation; and (7) final examination. In order to be considered for candidacy for a doctoral degree, the student must have passed all of his course work in the first year of graduate study; on at least 9 units of course work in the first year, he must have made a grade of *G* or better.

Foreign Language Requirements. A reading knowledge of at least one foreign language is required for the D.F. and Ph.D. degrees. Languages normally taken are French, German, and Russian. Another language which has a definite relation to the degree program and for which an examination can be provided may be substituted for any of these with the approval of the supervisory committee.

A foreign student whose native language is not English may request that the director of graduate studies ask permission of the dean of the Graduate School to offer English as the foreign language required in his program.

With the special approval of the dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. may be waived in individual cases provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the student concerned.

The foreign language requirement(s) may be satisfied in the following ways:

1. The student may take the Educational Testing Service examinations at many national centers (including the Duke University Counseling Center). To avoid delays, prospective students are urged to take appropriate ETS Graduate School Foreign Language tests prior to registration. However, it should be noted that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language certificates more than six calendar years old will not be accepted toward fulfilling the language requirement.

2. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week. French is offered during the fall semester and occasionally also in the spring and German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register, with permission of the dean of the Graduate School, in the summer session if total registration permits.

Major and Related Work. The student's program of study necessarily demands substantial concentration on courses in his major department. It must, however, include a minimum of 6 units in related fields approved by his major department. Use of related fields within the major department requires the approval of the dean.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and *not later than two months before the preliminary examination*, the director of graduate studies in the major department will nominate for the approval of the dean a supervising committee of five, with one member designated as chairman. This committee will include at least three members of the major department and one from the minor department, if a minor is involved. This committee will approve the program of study, as well as administer the preliminary examination and the final doctoral examination. Should all members of the committee be from the major department, at least one member of another department will be added or substituted for the final doctoral examination. The final examination may be administered with a minimum of four members.

When the preliminary examination is arranged, the committee and the director will submit to the dean the student's program of study bearing a statement that the department's course and language requirements have been, or are being, completed.

Residence. The *minimum* registration requirement is 60 units of graduate credit, not more than 30 units of which may be accepted by transfer. Since a full program is 30 units per academic year, the prospective doctoral candidate who enters with an A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if he enters with an A.M., M.S., or M.F. degree, his *minimum* residence is one academic year. If there are undergraduate deficiencies in his program, he may, in addition to the minimum requirements, be required to take preliminary undergraduate courses for which he will not receive graduate credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements, if any, above the minimum the student must meet. See pages 23-24 for further information on registration in residence and *in absentia.*

When the preliminary examination is passed, any courses, language certifications, or other credits for advanced standing which are more than six calendar years old will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

The student should normally pass the preliminary examination by the end of his second year of graduate study. If he has not passed it by the middle of the third year, he must file with the dean a statement explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the end of the third year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the dean for an extension of one year. Should this extension be granted and the dissertation not be submitted and accepted within the year, the student must pass a second preliminary examination to remain a doctoral degree candidate. In such a case, the time limit for submitting the dissertation will be determined by the dean and the candidate's committee.

Preliminary Examination. A student is not accepted as a candidate for the doctoral degree until he has passed the preliminary examination. A transfer student who may have passed a preliminary examination elsewhere must, nevertheless, take the examination at Duke. The examination ordinarily covers both the major and minor fields.

In the summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the dean, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program for the doctoral degree at Duke University.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

Not later than February 1 (February 2, if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the dean of the appropriate school, on the official form to be obtained from the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation such as quality of paper, form, and binding are prescribed in the instructions for microfilming (see below) and in the *Manual of Style for Theses and Dissertations*, revised 1961, which may be obtained from the Duke University Book Store, West Campus.

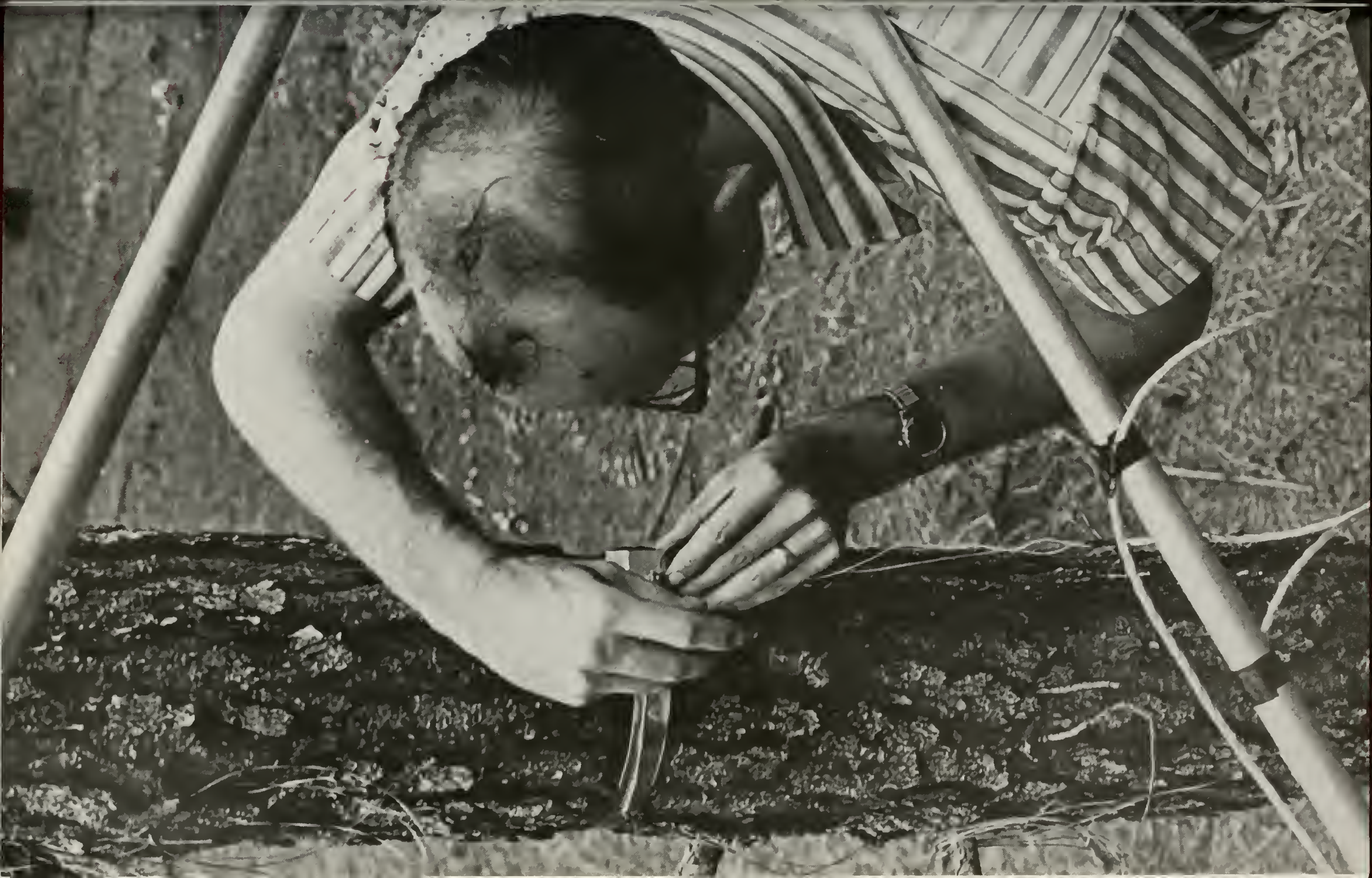
The dissertation must be completed to the satisfaction of the instructor who directs it. Four typewritten copies bound in snap binders secured through the Graduate School Office must be deposited with the dean of the appropriate school on or before April 1 preceding the May commencement when the degree is to be conferred. The dissertation must be submitted at least seven days before the scheduled date of the student's examination.

All doctoral dissertations will normally be published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may, if they wish, also copyright them. An abstract will be published in *Dissertation Abstracts*. Before final typing is completed, the candidate should obtain, in the Graduate School Office, detailed instructions on the procedure, together with a microfilming agreement which is signed and returned when the dissertation is finally deposited in the Graduate School Office.

In brief, all copies of the dissertation, the original in clean type, will remain unbound except for spring binders. Ten copies of an abstract, carefully written and not more than 600 words long, are submitted when the dissertation is first presented. A non-returnable dissertation fee of $25 is charged for handling and microfilming. If copyright is desired, an additional fee of $7 plus 2½ cents per page is charged. The original and two carbon copies will be bound by the Ruzicka Bindery for a fee of $5.00 a volume. The student may request that more than the three copies be so bound.

Final Examination. The final oral examination shall be based primarily upon the dissertation. Questions may, however, be asked in the candidate's major field. Except in unusual circumstances, approved by the dean, a final examination will only be scheduled when school is in session.

If a student fails his final examination, he may be allowed to take it for a second time, but not sooner than six months from the date of his first. Permission to take the second examination must be obtained from the instructor who directed the dissertation and from the dean. Failure to pass the second examination renders the student ineligible to continue work for the doctoral degree at Duke University.



3

Cooperative Plan of Study

Program with Selected Colleges and Universities

Since its inception the Duke School of Forestry has had the cooperation of Trinity College (the undergraduate college of arts and sciences of Duke University) in preparing students for professional careers in forestry. Under the plan, a student devotes his first three years to a coordinated and carefully integrated program of study in the basic arts and sciences in Trinity College. The following five semesters are spent in the School of Forestry, and normally upon successful completion of 70 units of credit in a professional program of study, a student will have earned the Bachelor of Science degree from Trinity College and the professional Master of Forestry degree from the Duke School of Forestry. In the case of students with advanced preparation relevant to their specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on individual bases and only with specific recommendation of the student's major program adviser and approval by the faculty.

Based upon the experience and success of this cooperative program with Trinity College, the School of Forestry in 1952 initiated similar programs of collaboration with a selected group of colleges and universities located throughout the United States. These programs offer students the numerous advantages of a broad background in liberal arts and sciences as preparation for later professional training. A student intent upon following such a course of study should make application to one of the colleges listed on pages 16-17. Admission requirements and other information pertinent to matriculation may be obtained from each of these institutions. Not later than the end of the first semester of the third year in the college or university of his choice, the student may take formal application for admission to the Duke University School of Forestry. To qualify for admission under these programs, a student must have followed a course of study arranged in consultation with his adviser, must have the official recommendation of his college, and must meet the minimum requirements for admission to the Duke School of Forestry.

Institutions in the Academic-Forestry Program

Alabama
Samford University   Birmingham 35209
Arkansas
Little Rock University   Little Rock 72204
Colorado
Colorado College   Colorado Springs 80903
Florida
Florida Southern College   Lakeland 33802
Rollins College   Winter Park 32791
Stetson University, College of Liberal Arts   DeLand 32720
Georgia
Mercer University   Macon 31207
Illinois
Illinois Wesleyan University, College of Liberal Arts   Bloomington 61710
Indiana
Butler University, College of Liberal Arts and Sciences   Indianapolis 46208
Indiana Central College   Indianapolis 46227
Iowa
Iowa Wesleyan College   Mount Pleasant 52641
Kansas
Baker University   Baldwin 66006
Louisiana
Centenary College of Louisiana   Shreveport 71104
Maryland
Western Maryland College   Westminster 21158
Michigan
Albion College   Albion 49224
Mississippi
Millsaps College   Jackson 39210
Missouri
William Jewell College   Liberty 64068
Nebraska
Doane College   Crete 68333
New Jersey
Drew University, College of Liberal Arts   Madison 07940
New York
Hofstra University   Hempstead, Long Island 11550
North Carolina
Catawba College   Salisbury 28114
Duke University, Trinity College   Durham 27706
Guilford College   Guilford College 27410
High Point College   High Point 27262
Wake Forest University   Winston-Salem 27106
Ohio
Baldwin-Wallace College   Berea 44017
Denison University   Granville 43023
Heidelberg College   Tiffin 44883
Kent State University, College of Liberal Arts   Kent 44240
Marietta College   Marietta 45750
Miami University, College of Arts and Sciences   Oxford 45056
Ohio University   Athens 45701
Otterbein College   Westerville 43081
Wittenberg University   Springfield 45501
Youngstown State University   Youngstown 44503
Oregon
Reed College   Portland 97202
Williamette University, College of Liberal Arts   Salem 97301
Pennsylvania
Albright College   Reading 19604
Elizabethtown College   Elizabethtown 17022

Franklin and Marshall College Lancaster 17603
Gettysburg College Gettysburg 17325
Juniata College Huntington 16653
Lebanon Valley College Annville 17003
Lycoming College Williamsport 17704
Moravian College Bethlehem 18018
Muhlenberg College Allentown 18104
Thiel College Greenville 16125

South Carolina

Furman University Greenville 29613
Newberry College Newberry 29108

Tennessee

Carson-Newman College Jefferson City 37760
Chattanooga, University of, College of Liberal Arts Chattanooga 37403
East Tennessee State University Johnson City 37602
Lincoln Memorial University Harrogate 37752
Tennessee Wesleyan College Athens 37303
Tusculum College Greeneville 37743

Texas

Baylor University, College of Arts and Sciences Waco 76706

Virginia

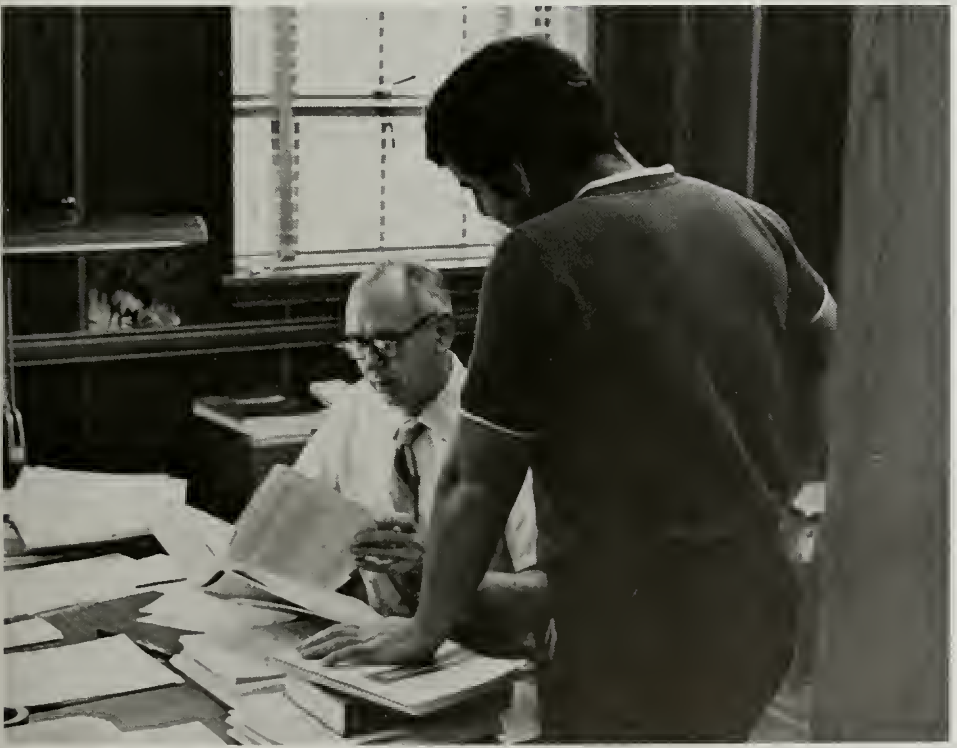
Bridgewater College Bridgewater 22812
Randolph-Macon College Ashland 23005
Richmond, University of, Richmond College Richmond 23173
William and Mary, College of Williamsburg 23185

West Virginia

Davis and Elkins College Elkins 26241
Marshall University Huntington 25701
West Virginia Wesleyan College Buckhannon 26201

Wisconsin

Beloit College Beloit 53512



4

Admission

Master of Forestry Degree

The admission requirements of the School of Forestry for work toward the Master of Forestry degree presuppose that an applicant is either:

1. a graduate of a professional school of forestry, or
2. a graduate of a college or university of high standing, but without prior professional training in forestry, or
3. a student who has successfully completed three years of approved study at one of the colleges (listed on pages 16-17) cooperating with the School in the academic-forestry program.

Each applicant must present a certified transcript of his academic record showing the courses he has taken, the number of credit hours earned, and the grades received. Although specific courses are not required for admission, applicants must be aware that many fields within forestry require academic preparation of a specialized nature. Deficiencies, if any, may be satisfied in residence, possibly prolonging the time necessary to complete degree requirements. Students interested in specialized areas of forestry should write the dean for advice as to specific preparatory courses.

An applicant who is a graduate of a professional school of forestry will present a certified transcript of his scholastic record. Before registering for the first semester of residence, students will be required to select the branch or branches of forestry in which they wish to concentrate the major part of their work and to prepare their proposed programs in conference with an appropriate faculty advisory committee. Ordinarily, graduates of a fully accredited school of forestry should be able to meet all requirements for the Master of Forestry degree in one full school year of resident study; others may require a longer period of residence.

Doctor of Forestry Degree

Admission to the School of Forestry for a program of study and research leading to the Doctor of Forestry degree is granted to a student who has received the Master of Forestry degree, or its equivalent.

An applicant must file a formal application for admission together with transcripts of his undergraduate and graduate academic records. In his application he should clearly state the branch of forestry in which he desires to concentrate, and if possible, his specific research interests.

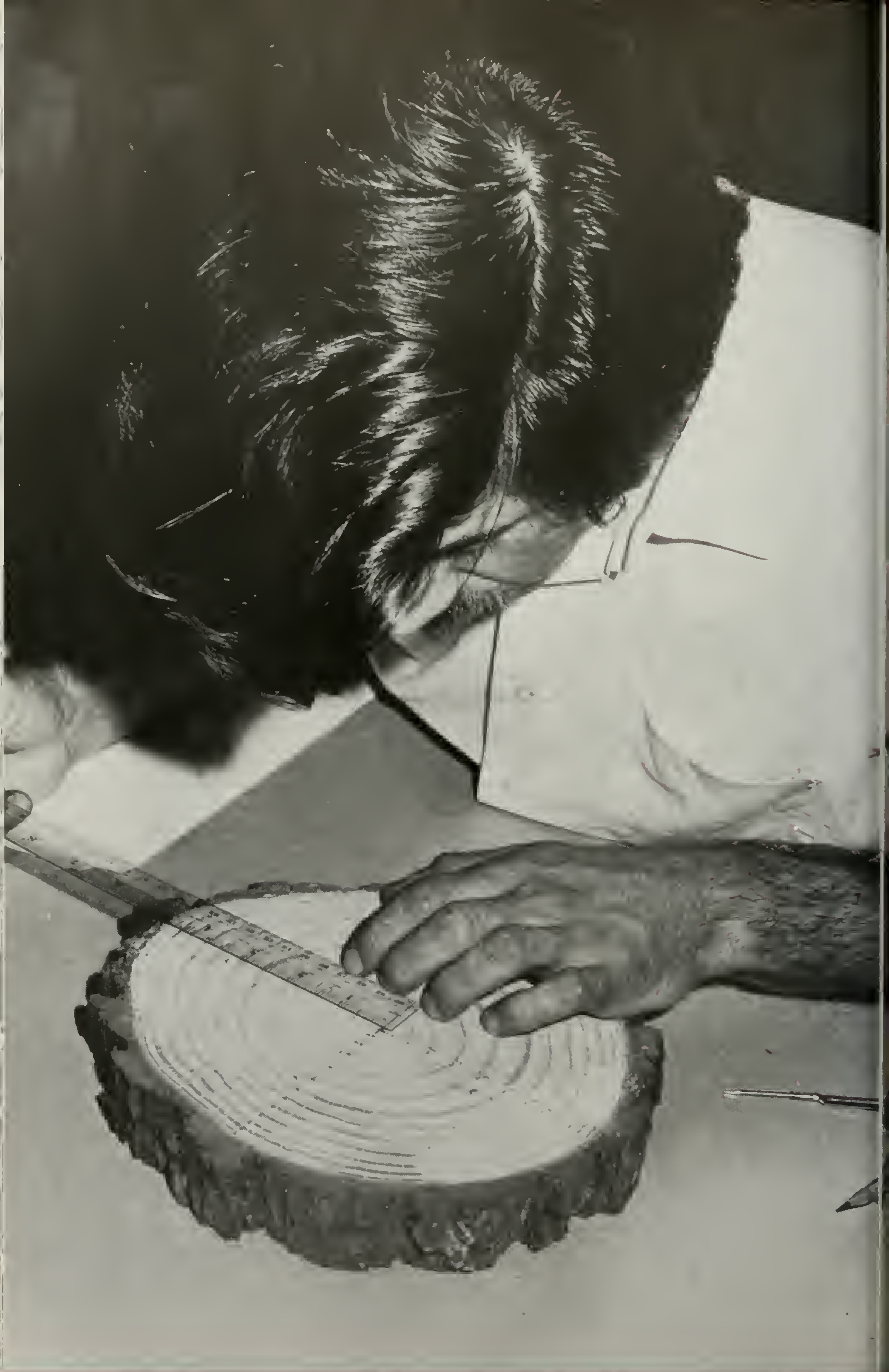
The director of admissions of the School of Forestry, together with the prospective student's major adviser, will determine if the qualifications of the applicant meet entrance requirements.

Master of Science and Doctor of Philosophy Degrees

Applications for admission into M.S. and Ph.D. programs in Forestry should be submitted to the director of admissions, Duke School of Forestry, for tranmittal to the Office of the Dean of the Graduate School.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of the capacity for graduate study.

Applicants for all degree programs of the School of Forestry will be considered for admission without regard to race, color, religion, sex, or national origin.



5

Registration and Regulations

Registration

All students who enter course work or residence for credit; all students who have completed minimum requirements for an advanced degree, but continue to use the facilities of the University in their research; all students *in absentia* status; and all students who wish merely to audit a course or courses must register.

After the applicant has received notification of his admission to the School of Forestry and has returned his statement of acceptance of admission, he may present himself for registration. During the registration periods, announced in this *Bulletin*, he first confers with an assigned faculty adviser who prepares and signs a course card, listing the course work to be taken during the semester. The student then presents this course card to registration officials, who enroll him officially in his courses. After his first registration period as a current student he will preregister at the stated times for preregistration. Failure to preregister incurs the penalty for late registration. Former students who intend to register to resume a degree program must give the director of admissions notice of this intention two months before registration. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

Late Registration. All students are expected to register or preregister at the times stated in this *Bulletin*. Those registering late, including those who are obliged to register *in absentia*, are subject to a late registration fee of $10.00.

Change of Registration. During the academic year within a period of fourteen days from the registration date, a student may change registration with the approval of his adviser, if no reduction of fee is involved, and with the approval

of the dean if a reduction of fee is involved. During the first thirty days from the registration date the only permissible change is dropping course-seminar registration and adding equivalent units of research, with the approval of his adviser, the instructor of the course, and the dean.

Normal Registration. A graduate student is designated as fully registered when he registers for the maximum credit his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in completion of degree requirements. In the academic year normal registration for the resident student who does not hold an appointment as part-time instructor or assistant, or does not engage in part-time work, is 15 units a semester or 30 units an academic year. The normal registration for the student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties.

The resident student in a terminal master's program which requires no thesis carries normal registration until he has met all degree requirements. If a thesis is required and the student has met all requirements except for submitting his thesis, he registers for 3 units a semester while in residence or, if he elects to go out of residence, for 1 unit *in absentia* each semester until the thesis is accepted.

The resident student engaged in a master's program which is not terminal but preparatory to a doctoral program registers as though he were a doctoral student.

The resident student in a doctoral program carries normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units a semester until the dissertation is accepted. If, before or after passing the preliminary examination, he elects to go out of residence, he registers for 1 unit a semester *in absentia* in order to keep his program active.

It is necessary to be a fully registered student according to the regulations listed above (except when registered *in absentia*) in order to establish eligibility for library carrel and laboratory space, for student housing, for University and some outside loans, for the Student Health service including voluntary insurance coverage, and for reporting status for military duty.

The registration of 1 unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

In the *summer session* 6 units a term is maximum registration. Students who are residents in the academic year and wish to continue study and the use of University facilities including Summer Session Student Health during the summer must register for 1 unit in the first summer session term. This registration provides use of these facilities for all terms.

Academic Regulations

Transfer of Graduate Credits. Credit for graduate course work earned at another institution will be determined only after a student has spent one semester at Duke University. After completing his first semester, the student, through his director of graduate studies, should file a request that his credits be reviewed and a decision be made.

Grades. Grades in the School of Forestry are as follows: *E* (exceptional); *G* (good); *S* (satisfactory); *F* (failing); and *I* (incomplete).

An *I* (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. The instructor who gives an *I* for a course specifies the date at which the student must make up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is entered upon the student's record unless his appeal to the dean for the grade *No Credit* is approved.

A grade of *F* in any course normally occasions withdrawal from a degree program.

Reciprocal Agreements with the University of North Carolina and North Carolina Central University. Under a plan of cooperation between the University of North Carolina and Duke University, students regularly enrolled in the Graduate Schools of the University of North Carolina during the regular academic year, and paying full fees to that institution, may be admitted to a maximum of two courses per semester in the Graduate School of Duke University upon payment of a nominal registration fee of two dollars and of any other special fees regularly required of all students. Under the same arrangements, students in Forestry and the Graduate Schools of Duke University may be admitted to course work at the University of North Carolina and North Carolina State University. A similar arrangement exists with North Carolina Central University at Durham.

6

Resources for Study

General and Research Facilities

The School of Forestry is housed in the south wing of the Biological Sciences Building on the West Campus. General and research laboratories are provided for routine and original studies in all of the subject matter fields. These laboratories are equipped with instruments and facilities for quantitative evaluation of biological materials and processes. Greenhouses and the phytotron immediately adjacent to the Biological Sciences Building and the nearby Duke Forest offer excellent facilities for biological investigations in controlled and natural environments. An IBM system 370 Model 165 Digital Computer is available for processing research data via a teletype terminal at the School.

Facilities of allied departments of the University are also available for advanced worked in chemistry, economics, genetics, mathematics, plant anatomy, plant ecology, plant pathology, and plant physiology.

West Virginia Pulp and Paper Company has made available to Duke University a field headquarters for work in the forests of the South Atlantic Coastal Plain. This camp, located eighteen miles northwest of Summerville, South Carolina, is used as a base for field instruction in timber harvesting, wood utilization, soils, silviculture, and forest management.

The School periodically sponsors conferences and symposia on industrial forest management and other technical and scientific subjects. These offer the current viewpoints of many outstanding individuals in both forestry and in allied fields.

The University library, with 2,000,000 volumes and 4,000,000 manuscripts, provides exceptional resources and facilities for study and research by undergraduate and graduate students, and by visiting scholars. About 80,000 volumes are added annually, and 164 foreign and domestic newspapers and 9,800 periodicals are received currently. Large collections of microfilms of rare books, newspapers, and periodicals are also available.

The Biology-Forestry library, Chemistry library, and Physics-Mathematics library are housed for convenience in the buildings of these departments. The libraries of the Schools of Divinity, Law, Medicine, and Engineering are also housed in the buildings of these schools, all on the West Campus. The library on East Campus includes another 171,000 volumes.

The Duke Forest. The Duke Forest, of approximately 8,000 acres, is particularly well situated for field work. A five-minute walk from the campus will take one well into many parts of the area, and even the most distant portions can be reached by automobile in about twenty minutes.

At few other places in America are there provisions for extensive field study and research in forestry literally at the door of a large university. This natural outdoor laboratory, so conveniently located and representative of the region, is a most valuable supplement to the instructional, laboratory, and library facilities of Duke University.

The forest lies mainly in Durham and Orange Counties near the eastern edge of the Piedmont Plateau. A cross section of much of the woodlands in the upper coastal plain and lower Piedmont of the Southeast is represented in the forest with its variety of topography, soil, forest conditions, and patterns of past land use. Elevations range from 280 to 760 feet. The soils are derived from such diverse parent material as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives. Nearly one hundred tree species are represented. Some eighteen miles of improved woods roads make all parts of these woodlands readily accessible. It serves as an outdoor laboratory for instruction in forestry and allied fields, and as an experimental forest for research in problems of timber growing and in the sciences basic thereto. It is also used to demonstrate methods of silviculture and forest management applicable to the region.

Forestry Sciences Laboratory. The establishment of the Forestry Sciences Laboratory of the United States Forest Service's Southeastern Forest Experiment Station in the Research Triangle Park near Durham provides an unusual opportunity for complementing the research programs of students in the School of Forestry. Specialized research projects in forest entomology, pathology, and soils are currently under way at the laboratory. The research staff of the laboratory is available for consultation, participation in seminars, and service on graduate committees of students in the School of Forestry. Arrangements may also be made for students to conduct certain aspects of their research at the laboratory.

Phytotron. A controlled environment plant growth facility adjoins the Biological Sciences Building. The Duke phytotron contains fifty separately controlled environmental areas. In the chambers and greenhouses it is possible to dissect or reproduce any total environment in the world. Using this procedure, one can study the influence of many environmental factors on the growth processes of trees. The chambers accommodate trees up to six feet tall, the greenhouses even larger plants. The Duke phytotron is one of three such laboratories in the United States.

Duke Environmental Center. The Duke Environmental Center is an inter-

disciplinary University-wide organization for encouragement and coordination of research and training in environmental subjects. The Center provides students access to coursework, research, and expertise in all departments of the University and outside agencies involved in environmentally related activities, as well as sponsoring environmental courses and seminars and maintaining an environmental reading and reference room. Students in the School of Forestry may become affiliated with the Environmental Center through working with one of several forestry faculty members who are involved in Center activities.

National Environmental Research Center. The Durham area has the greatest concentration of Environmental Protection Agency offices and activities outside of Washington, D.C. The EPA National Environmental Research Center in the Research Triangle Park is the national center of air pollution research and regulation activities. This facility provides a unique opportunity for cooperative research and advanced training in air pollution and other environmental subjects.

7

Student Life at Duke

Living Accommodations

Housing. Duke University provides residence hall and apartment accommodations for single graduate and professional men and women. Since no married student housing facilities are presently available, the University provides assistance to married graduate and professional school students in locating suitable housing in Durham where varied types of living units are reasonably available.

The Graduate Center, near the Medical Center, and Town House Apartments houses men and women enrolled on a full-time basis in the graduate and professional schools. Town House Apartments are located between East and West Campuses.

The Graduate Center houses 189 male graduate students, 56 female graduate students, and 117 female undergraduate students. Commons facilities on the main floor are shared by men and women.

Students are normally licensed to occupy graduate residential space for the academic year, but for no period less than a semester or specified term.

Duke University operates Town House Apartments primarily for graduate and professional school students. Others are housed in individual apartments if the interests of the University are served. There are 30 two-bedroom units, each furnished for three occupants. Two students occupy the master bedroom with adjoining half-bath, and the third occupies a smaller bedroom. A living room, kitchen, and full bath complete the living arrangement. Additional features are air-conditioning and a swimming pool. The campus bus, serving all parts of the University, is accessible to the Town House Apartments.

The Department of Housing Management is prepared to assist the married graduate and professional school students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and duplex units are available in limited numbers from time to time.

Detailed information about University housing facilities for single students, and the housing assistance program for married students, will be provided upon request by the Department of Housing Management, Duke University, Duke Station, Durham, N.C. 27706.

Rooms in residence halls and spaces in the Town House Apartments or other residential units may be reserved by applicants only if they have been accepted by the graduate or professional schools, and after the required $50.00 residential deposit has been paid to the University. The initial residential deposit is required with the application and is held until the room or apartment is vacated. Application forms and detailed information on graduate housing will be mailed when the graduate or professional schools have notified the Department of Housing Management of official acceptance of the student. Single students may express a choice for the type of housing desired. Completed applications or rooms and apartments are to be returned with the required deposits, to the Department of Housing Management, Duke Station, Duke University, Durham, North Carolina 27706. Assignment priority is established by the date of receipt of completed applications with deposits in this office.

Regulations governing occupancy of rooms and apartments will be provided by the Department of Housing Management at the time application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

For the cost of housing, see the section on Financial Information.

Dining Service. The dining facilities on the West Campus include two cafeterias with multiple-choice menus, a snack bar, and the Oak Room where full meals and *a la carte* items are served. In the Graduate Center there is a cafeteria with multiple-choice menus and a coffee lounge where sodas and sandwiches are served.

Due to the large number served in the dining halls, it is not possible to arrange special diets for individual students. Special diets for the sick are served in the infirmary.

Services Available

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The University Health Services Clinic offers the student outpatient services, routine laboratory, and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and sum-

mer sessions to all currently enrolled full-time students. To secure the benefits of these services, a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

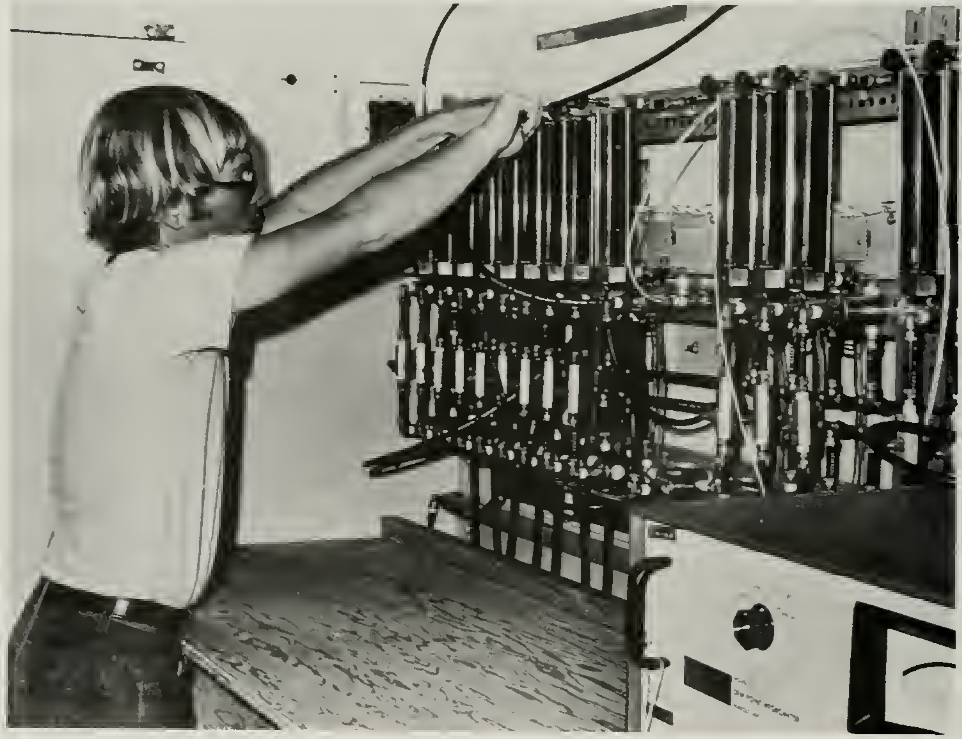
The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged for, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve month period. The 1972-73 rate is $29.90 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. *The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources.* Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete.* The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full 12-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from August 31. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the dean of the Forestry School.

The Duke University Counseling Center. Through the counseling center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.



Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with students about their future professional plans. Students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations are far easier to accumulate during the time a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Placement Office for those students who have registered. Copies of academic records are released only with the permission of the individual.

Student Activities

Forestry students new to Duke University are reminded that they are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, instrumental, drama, and religious groups.

Students are encouraged to maintain broad professional contacts by participation in the activities of the Society of American Foresters, the Forest Products Research Society, the national honorary scientific society of Sigma Xi, and other societies appropriate to their major field of study.

The social and business events of the Forestry Club provide opportunities for many pleasant extracurricular activities. An active organization of the wives of forestry students, the Forestry Dames, offers a regular schedule for social occasions of interest to this group.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as are currently in effect or, from time to time, are put into effect by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations, or for conduct adjudged unsatisfactory or detrimental to the University.

Visiting Scholars

The libraries and, to the extent practicable, other facilities of Duke University will be made available to faculty members of colleges and universities who wish to spend a period of time on the campus in pursuit of their scholarly interests. No fees will be charged such visitors unless they wish to participate in activities for which a special fee is assessed. Room and board may be arranged for at the regular rate in the dormitories and dining rooms. Dormitory space is usually available during the summer months. Inquiries concerning residence for visiting scholars should be directed to the dean of the Graduate School.

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Financial Information

Tuition and Fees*

The following table shows the charges collected from all students for the year 1972-73. All charges for each semester are due and payable, unless otherwise specified, at the time of registration and no student is admitted to classes until arrangements have been made with the Bursar of the University for the settlement of such charges. After the day of registration, no refund of tuition will be made except for involuntary withdrawal to enter the armed services or in accordance with established University policy.

Tuition, per semester	$1175.00
Spring field seminars	10.00
In Absentia Fee, per semester (when applicable)	80.00

Forestry students may obtain admission to all regularly scheduled University athletic contests held on the University grounds during the entire academic year by payment of an athletic fee of $25.00 per year, plus any federal taxes that may be imposed. This fee is payable in the fall semester.

Audit Fee. If a student registers and pays fees for 12 units or more, he may audit one course without charge. Should he be permitted to audit a second course or should he be registered for less than 12 units the audit fee is $40.00 per course.

Transcripts. A student may request transcripts of his academic record. A minimum fee of one dollar, payable in advance, is charged for a single copy. A charge of $ .50 will be made for each additional copy of the same order.

*Although these fees are based upon existing charges, they are subject to change.

Debts. No records are released and no student is considered by the faculty as a candidate for a degree until he has settled with the Bursar for all indebtedness.

Living Accommodations

Housing Fee. The charge for each person in a double room for the academic year is $340.00 in the Graduate Center. A limited number of single rooms are reserved for returning students.

The fees for Town House Apartments is $626 each for the academic year on the basis of three students to an apartment. Utility charges are included in these fees.

Housing fees are subject to change prior to the 1973-74 academic year. A $50.00 deposit is required on all reservations.

No refund on housing fees is made to students who withdraw after the date of registration, except for those who involuntarily withdraw to enter the armed services. Such refunds will be made in accordance with the University's established schedules.

For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

Dining Service. The cost of the dining facilities discussed on page 32 will approximate $600.00, depending on the tastes of the individual.

Motor Vehicles

Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of $10.00 for each automobile or $5.00 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least $10,000 per person and a $20,000 per accident for personal injuries, and $5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Estimated Expenses for the Academic Year

The following table represents an estimate of a graduate student's basic expenses in the School of Forestry for the year 1972-73. It should be noted, however, that this estimate does not include any allowance for travel, clothing, and other miscellaneous expenses, inasmuch as these costs will vary depending on the needs, habits, and tastes of the individual.

	Low	*Moderate*	*Liberal*
Tuition	$2350 ~~$1175.00~~	~~$1175.00~~	~~$1175.00~~
Room-rent*	340.00	340.00	450.00
Board	600.00	650.00	700.00
Laundry	30.00	40.00	50.00
Books	50.00	65.00	100.00
Athletic Fee (Optional)	25.00	25.00	25.00
Spring field seminars	10.00	10.00	10.00

*In the Graduate Center.

Student Aid

A number of fellowships, scholarships, and assistantships are allocated to the School of Forestry for the encouragement and financial assistance of men and women who offer promise of becoming leaders in the forestry profession. These are awarded to applicants of high character on the basis of scholastic ability as judged by previous educational performance, professional experience, personal references, and the Graduate Record Examination. Holders of the awards will pay tuition and such additional fees as are regularly required.

Fellowships. Stipends range from $2,300-$4,000 per academic year. Each recipient must have previously completed work equivalent to that required at Duke University for a master's degree with a major in forestry or in a discipline basic to forestry. He will devote his time to an approved program of study and research in any of the branches of forestry. He is expected to become a candidate for the degree of Doctor of Forestry or Doctor of Philosophy.

Scholarships. Stipends range from $600-$3,200 per academic year. Each recipient will normally devote his time to an approved program of study leading to the degree of Master of Forestry, or Master of Science with a major in forestry.

Graduate Assistantships. Graduate assistantships have variable stipends up to $4,000, depending upon available funds and upon whether granted for the academic year only, or the academic year plus the summer. Each recipient will devote half-time to research or other work of the School of Forestry. He will be permitted to enroll for not more than 24 units in an academic year in an approved program of study, or study and research.

Application for Awards. Any student admitted to the School of Forestry is eligible to apply for a fellowship, a scholarship, or an assistantship. Application for these awards may be made concurrently with the application for admission.

The general procedures and requirements for applying for any financial award in the School of Forestry are outlined below. Applicants should initiate the necessary action early to ensure that the required documents are filed with the dean of the School of Forestry on or before March 1 prior to enrollment.

1. File award application. Form will be supplied by the School of Forestry upon request.
2. Furnish supporting documents as follows: (a) official transcripts of record of all previous college or university credits earned and (b) letters of reference from at least three persons familiar with the applicant's character scholarship, and professional ability. (Documents offered in support of admission, if so designated, may also serve in support of the application for financial award.)
3. Complete the Aptitude Test of the Graduate Record Examination. Instructions and application for admission to this locally administered examination are available on most college campuses, from the Duke School of Forestry, or by writing the Educational Testing Service, Princeton, New Jersey. Applicants should plan to take this examination in January or earlier.

Notification of awards is made on April 1. In case vacancies occur, completed applications received after March 1 will be considered at a later date.

In every instance where a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or prospective graduate student and accepted before April 15, the recipient may resign his appointment without prejudice prior to that date by notification in writing to the dean. However, an acceptance given or left in force after April 15 obligates him not to accept another appointment without first obtaining formal release from the dean of the School.

Loans

Students who are enrolled as full-time degree candidates and who have satisfactory academic and citizenship records are eligible to apply for student loans.

Champion Paper Foundation Fund. Established in 1971 by a grant of the Champion Paper Foundation in support of the School of Forestry. Forestry students may apply for assistance from this fund through the University Student Loan Office.

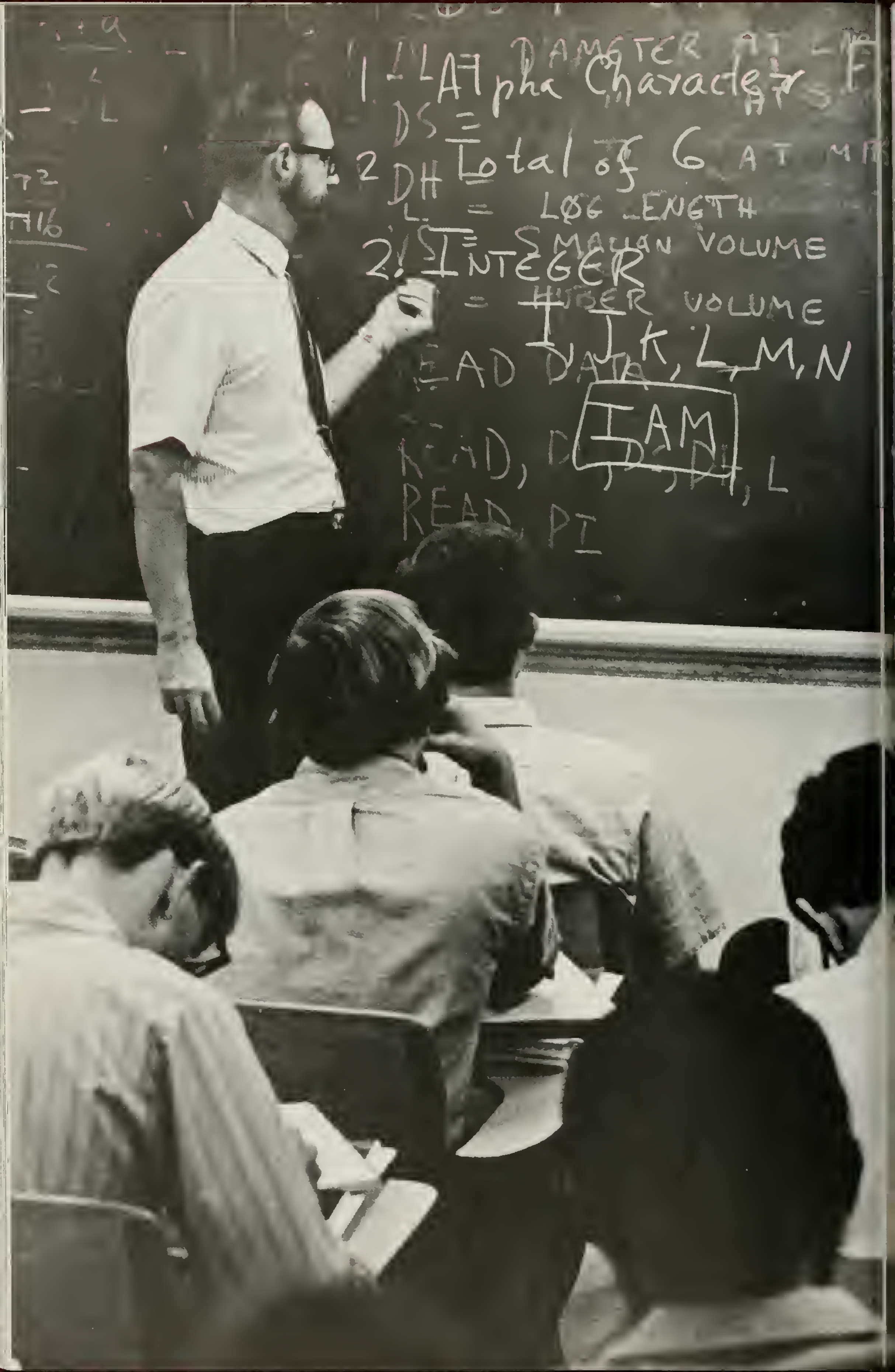
University Student Loans. Loans from University funds generally mature after borrowers have left the University. Interest accrues on long-term loans from University funds at the rate of 1 percent per annum from the date of each note.

After a student has left the University permanently, the loans begin accruing interest at the rate of 3 percent per annum for a period of five years. Interest accrues at the rate of 6 percent after the 3 percent ceases to be effective.

Other Funds. In addition to local loan funds, Duke University participates in the student loan program established under the provisions of the National Defense Education Act of 1958. Repayment of these loan funds normally begins one year after the student terminates full-time study. Interest accrues at the rate of 3 percent per annum commencing one year after termination of full-time study. Upon completion of the period of grace of twelve consecutive months, the ten-year annual repayment period begins, and simple interest on the loan at the rate of 3 percent starts to accrue. At this point the borrower still has one additional year before his first annual payment becomes due. The first annual installment will, therefore, fall due twenty-four months after the borrower has ceased being a full-time student.

Special benefits to those teaching in non-profit schools, colleges, and universities permit a portion of the loan to be cancelled, depending upon the length of teaching service.

Applications and complete details regarding the student loan program may be obtained by writing to the Student Loan Division of Duke University. In approving loan applications, the Student Loan Committee selects those students who, from the standpoint of character, scholastic attainment, personality, and degree of financial need, are deserving of this consideration. All applications for loans should be made before July 1 preceding the academic year in which the student plans to matriculate.


1. Alpha Character
DIAMETER AT
DS =
2 DH Total of 6 AT
DL = LOG LENGTH
S = SMALIAN VOLUME
2. INTEGER
= HUBER VOLUME
I, J, K, L, M, N
READ DATA
I AM
READ, D, DS, DH, L
READ, PI

9

Courses of Instruction

General

152. Conserving Natural Resources. Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. 3 units. *Staff*

200. Careers in Natural Resources. A weekly seminar which surveys the research and managerial career opportunities in all fields of renewable natural resources. Required of students in Academic-Forestry program. No credit. *Staff*

Forest Biology

DENDROLOGY AND WOOD ANATOMY

241. Dendrology. Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. *Harrar and White*

290. Wood Anatomy. Study of the physical features and the gross and minute structural characteristics of wood leading to the identification of the commercial woods of the United States, and the important tropical woods used in American wood-working industries. Prerequisites: one year of biology. Forestry 241, or equivalent. 3 units. *Harrar*

292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 290 or equivalents and approval of instructor. 3 units. *Harrar*

398. Timbers of the World. A study of the properties of various groups of tropical and temperate zone woods, with particular emphasis upon those used in marine construction and for lumber, plywood, decorative paneling, and furniture. Prerequisite: Forestry 290 or equivalent. 2 units. *Harrar*

Related courses in other departments include—*Botany*: Anatomy, Systematics, Physiology; *Chemistry*: Organic Chemistry; *Civil Engineering*: Mechanical Behavior of Materials.

ECOLOGY

243. Natural Resource Ecology. An introduction to modern ecology with emphasis on natural resource management. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: consent of instructor. 3 units. *Wuenscher*

340. Ecology and Land Use Planning. Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Forestry 341 and consent of instructor. (Not offered in 1973-74.) 3 units. *Wuenscher*

341. Ecological Principles in Environmental Management. Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Forestry 243 or other substantive coursework in ecology. 3 units. *Wuenscher*

346. Seminar in Environmental Policy. Discussion of the political, legal, and and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and 341 or their equivalents and consent of instructors. 2 units. *Convery and Wuenscher*

347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. 1 unit. *Knoerr and Wuenscher*

354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of characteristics and dynamic behavior of biological populations; development and evaluation of mathematical models for ecological, physiological, and environmental systems. Simulation techniques for ecosystem analysis will be considered. Prerequisites: Forestry 204, 243, 253, and 353. 3 units. *Chapman, Yandle, and Staff*

Related courses in other departments include—*Botany*: Ecology, Plant-Water Relations, Community Analysis and Classification, Principles of Plant Distribution, The Environment, Vegetation of North America, Evolution; *Zoology*: Animal Behavior, Vertebrate Zoology.

PHYSIOLOGY AND BIOCHEMISTRY

201. Tree Physiology. A general survey of the major physiological processes in trees and other plants, including food synthesis, growth, and water relations. Special project and term paper required. Lectures, laboratories, and readings. Prerequisite: permission of instructor. (Listed also as Botany 251.) 3 units. *Hellmers*

205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes*

207. Chemistry of Wood Tissues. Composition of wood at the elemental, molecular, and macromolecular levels, both in woody plants and in processed woods. Distribution and properties of main components and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. *Barnes*

208. Physiology of Wood Formation. Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. *Barnes*

305. Forest Tree Biochemistry. Study of the biological synthesis, function, and degradation of the main biochemical constituents of trees. Emphasis on cellulose and other cell-wall polysaccharides, lignins, terpenes, and phenolics and other extractives. Prerequisites: Forestry 201 and a course in biochemistry. 3 units. *Barnes*

Related courses in other departments include—*Botany*: Anatomy, Plant Metabolism, Plant-Water Relations, Physiology of Growth and Development; *Biochemistry*: Introductory Biochemistry, Chemistry of Natural Products; *Chemistry*: Organic Chemistry, Chemical Instrumentation.

PATHOLOGY

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work, with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

223. Forest Pathology. Survey of major diseases of North American forests and their timbers, with emphasis on current literatures. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 3 units. *Stambaugh*

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology and their application to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*

322. Microbiology of Forest Soils. Qualitative and quantitative characterization of the microbial populations of forest soils, with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: Consent of instructor; mycology or bacteriology is recommended. 3 units. *Stambaugh*

385. Seminar in Forest Protection. Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. *Anderson and Stambaugh*

Related courses in other departments include—*Botany*: Mycology, Plant-Water Relations, Physiology of Growth and Development, Cytology, Genetics; *Chemistry*: Organic Chemistry; *Zoology*: Biological Nucleonics; *Biochemistry*: Introductory Biochemistry.

ENTOMOLOGY

222. Biology of Forest Insects and Diseases. (See description under Pathology above.)

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of the materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. *Barnes*

230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 3 units. *Anderson*

233. General Entomology. Principles of morphology, metamorphosis, and taxonomy of insects. Prerequisites: one course in entomology or zoology, or consent of the instructor. (Offered alternate years on sufficient demand.) 4 units. *Anderson*

331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. (Offered alternate years on sufficient demand.) 3 units. *Anderson*

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects, with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology, or consent of the instructor. 3 units; 4 units with laboratory. *Anderson*

335. Entomological Research Techniques. Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. *Anderson*

385. Seminar in Forest Protection. (See description under Pathology above.)

Related courses in other departments include—*Zoology*: Ecology, Systematic Zoology, Radiation Biology, Biological Nucleonics, Cellular Physiology, Invertebrate Embryology, Genetics; *Chemistry*: Organic Chemistry; *Biochemistry*: Introductory Biochemistry; *Botany*: Bacteriology; *Microbiology and Immunology*: Microbiology.

Environmental Science

347, 348. Natural Resource Ecology—Environmental Management Seminar. (See description under Ecology above.)

SOILS

261. Soils and Forest Resources. Origin, development, and classification of soils, with special emphasis on those developed in humid climates; morphological, physical and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2 and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. *Ralston*

362. Forest Soil Physics. Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. 3 units. *Ralston*

364. Soil Classification and Mapping. Classification of soils as natural bodies. Mapping of soils, land-use classes and forest-site classes; field study will be made of soil in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. *Ralston*

366. Forest Soil Fertility. The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 261; analytical chemistry is recommended. (Not offered in 1973-74.) 3 units. *Ralston*

Related courses in other departments include—*Botany*: Plant-Water Relations, Physiology of Growth and Development; *Biochemistry*: Introductory Biochemistry; *Chemistry*: Chemical Instrumentation, Elements of Theoretical Chemistry; *Geology*: Sedimentary Minerals.

METEOROLOGY

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Vukovich*

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

215. Air Pollution Meteorology. The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: Forestry 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from N.C. State University). 3 units. *Staff*

217. Environmental Instrumentation. Consideration of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Two lectures and three laboratory hours per week. Prerequisites: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

304. Atmospheric Turbulence and Diffusion. Bulk and molecular aspects of atmospheric turbulence; Navier-Stokes equations and the Reynold's stresses; mixing-length and statistical turbulence theories; similarity hypotheses; turbulent transfer and diffusion in adiabatic and diabatic atmospheres; characteristics of turbulence in various scales of motion from the planetary to sub-inertial range. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

306. Dynamics of Local Atmospheric Motion. Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale-forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves, and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

344. Micrometeorology. Physics of the earth's surface environment, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon-dioxide in relation to exchange processes within the biosphere; local circulation and eddy diffusion; principles of micrometeorological measurement. Prerequisites: Forestry 203, or equivalent, and calculus. 4 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Mechanical Engineering*: Fluid Mechanics, Thermodynamics, Heat Transfer, Transport Phenomena, Boundary Layer Theory; *Mathematics*: Applied Mechanical Analysis, Numerical Analysis; *Chemistry*: Physical Chemistry, Chemical Instrumentation; *Botany*: Ecology, Plant-Water Relations.

HYDROLOGY

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of stream. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 3 units. *Hellmers*

342. Hydrologic Processes. Physical processes of the hydrologic cycle, with emphasis on those processes which can be modified or controlled by watershed management. 3 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Civil Engineering*: Hydrology, Incompressible Fluid Flow, Mechanics of Fluids; *Mechanical Engineering*: Transport; *Chemistry*: Physical Chemistry, Chemical Instrumentation; *Botany*: Ecology, Plant-Water Relations.

Resource Economics and Management

ECONOMICS AND POLICY

269. Resource Economics and Policy. Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. *Convery*

270. Economics of Forestry. Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services; problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy, including attention to relevant institutional factors. Prerequisite: Forestry 269 or equivalent. 3 units. *Convery*

271. Financial Management. Analysis of the problems of management of the financial affairs of the firm: working capital, long-term capital needs, including the development of an optimal capital structure, with attention to tax problems. 3 units. *Joerg*

272. Business Policy. An integrating course where, through analysis of case problems from the top management viewpoint, the student is given practice in arriving at effective courses of action for the solution of business problems. 3 units. *Joerg*

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. (Not offered in 1973-74.) 3 units. *Convery*

377. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced-level course in non-market decision-making or Forestry 378 or its equivalent. 2 units. *Convery*

378. Seminar in Forest Economics. Examination and discussion of the application of economic concepts in forestry; the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. *Convery*

Related courses in other departments include—*Economics*: Economic Theory, History, and Systems; Economic Development, Planning, and Fluctuations; Economic Statistics; Monetary and Fiscal Theory and Institutions; International Economics; Manpower, Labor, and Population; Industrial Organization and Public Policy; *Business Administration*: Business Finance, Marketing, and Accounting.

MANAGEMENT

210. Forest Utilization. Introduction to utilization in the managed forest and the principal wood-using industries. A one-week field seminar is an integral part of the course. 2 units. *Yandle*

244. Theory and Practice of Silviculture. Principles governing establishment, treatment, and control of forest stands; natural and artificial methods of reproduction, intermediate cuttings, and cultural operations, with emphasis on the principal forest types of temperate North America. Field practice in silvicultural operations and study of managed stands. Prerequisite: Forestry 243 or equivalent. 3 units. *White*

248. Forest Regeneration. The fundamentals and application of forest tree improvement, nursery operations, and site-improvement techniques to the regeneration of forest stands by artificial and natural means. 3 units. *Chaiken and White*

256. Forest Measurements. Application of plane-surveying technique to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. *White*

281. Forest Management. Principles of organizing forest properties for systematic management; use of data obtained in surveys and inventories; principles of forest regulation, including a study of normal and actual forests, rotations, cutting cycles, and methods of regulating the cut in even-aged and all-aged forests for sustained yield; introduction to the preparation of preliminary forest management plans. 3 units. *Chaiken*

283. Fire Behavior and Use. Impact of destructive agencies upon forests; principles of combustion, fire behavior, danger measurement, and suppression; use of fire in forest management. 2 units. *Chaiken*

289. Interpretation of Aerial Photographs. Principles of aerial photography and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. Corequisite: Forestry 281 or equivalent. 3 units. *Chaiken*

382. Legal Aspects of Forestry. A seminar on certain state and federal laws pertinent to the management of forests: land ownership, trespass, public liability, timber contracts, labor relations, and use of pesticides. 1 unit. *Chaiken*

386. Seminar in Forest Management. Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the South; discussion of problems of large scale intensive forest management. Prerequisites: Forestry 244, 281, and 377 or equivalent. 1 unit. *Chaiken*

Related courses in other departments include—*Business Administration*: Theory of Firm, Organization Theory, Information Systems, The Firm in Society; *Political Science*: Public Administration; *Social Science*: Social Stratification, Industrial Sociology.

Statistics and Operations Research

250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. *Yandle*

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. *Yandle*

253. Computer Science in Natural Resources. Components and organization of a computer system; automatic programming languages; storage and retrieval systems (SAS); equation fitting by iteration and least-squares methods; graphical techniques. 3 units. *Chapman*

258. Operations Research. Mathematical model formulation and development of techniques to aid decision-making in problems of natural resource allocation and use. Includes the theory and techniques of inventory control, equipment replacement planning, queuing theory, competitive strategies, allocation, sequencing, and dynamic programming. Consideration is given to both deterministic and nondeterministic models. 3 units. *Chapman and Yandle*

352. Theory and Applications of Linear Statistical Models. Theoretical development of the general linear statistical model, together with extensions to accommodate linear approximation of non-linear cases. Curve-fitting techniques are developed, with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. *Chapman*

353. Design and Analysis of Experiments. Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete block models are developed as special cases of the general theory. Emphasis is placed on field and laboratory designs, together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. *Chapman*

354. Quantitative Analysis of Ecological and Environmental Systems. (See description under Ecology above.)

Related courses in other departments include—*Mathematics*: Calculus, Numerical Analysis, Complex Analysis, Non-parametric, Statistics, Probability, Applied Mathematical Statistics, Stochastic Processes, Multivariate Statistics; *Economics*: Econometrics, Quantitative Analysis.

Special Studies and Research

299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students is offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged.

1. *Forest Ecology.* Prerequisite: Forestry 243 or equivalent. *Wuenscher*
2. *Forest Soils.* Prerequisite: Forestry 261 or equivalent. *Ralston*
3. *Silviculture.* Prerequisites: Forestry 243 and 244 or equivalents. *White*
4. *Forest Management.* Prerequisite: Forestry 281 or equivalent. *Chaiken*
5. *Forest Economics.* Prerequisite: Forestry 270 or equivalent. *Convery*
6. *Wood Anatomy and Properties.* Prerequisites: Forestry 241 and 290 or equivalents. *Harrar*
7. *Forest Mensuration and Biometry.* Prerequisites: Forestry 250 and 352 or equivalents. *Chapman*
8. *Forest Entomology.* Prerequisite: Forestry 230 or equivalent. *Anderson*
9. *Forest Operations Research.* Prerequisite: consent of instructor. *Yandle*
10. *Dendrology.* Prerequisite: Forestry 241 or equivalent. *Harrar and White*
11. *Forest-Tree Physiology.* Prerequisites: plant physiology and plant or forest ecology. *Kramer, Hellmers, and Barnes*

12. *Forest Pathology.* Prerequisites: plant physiology and Forestry 223 or equivalents. *Stambaugh*

13. *Forest Meteorology and Hydrology.* Prerequisites: Forestry 203, 342, or equivalents. *Knoerr*

14. *Forest Biochemistry.* Prerequisites: plant physiology and organic chemistry. *Barnes*

368. Field Seminars. Field studies, consultations, and visits to areas of interest during spring vacation period, or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. *Staff*

Numerical Listing of Courses

152. Conserving Natural Resources. 3 units
200. Careers in Natural Resources. No credit
201. Tree Physiology. 3 units
203. General Meteorology. 3 units
204. Microclimatology. 3 units
205. Tree Growth and Development. 3 units
207. Chemistry of Woody Tissues. 3 units
208. Physiology of Wood Formation. 3 units
210. Forest Utilization. 2 units
215. Air Pollution Meteorology. 3 units
216. Watershed Hydrology. 3 units
217. Environmental Instrumentation. 4 units
222. Biology of Forest Insects and Diseases. 4 units
223. Forest Pathology. 4 units
225. Chemical Aspects of Forest Protection. 3 units
230. Forest Entomology. 3 units
233. General Entomology. 4 units
241. Dendrology. 3 units
243. Natural Resource Ecology. 3 units
244. Theory and Practice of Silviculture. 3 units
248. Forest Regeneration. 3 units
250. Biometry. 3 units
251. Theory and Methods for Sampling Biological Populations. 3 units
253. Computer Science in Natural Resources. 2 units
256. Forest Measurements. 4 units
258. Operations Research. 3 units
261. Soils and Forest Resources. 3 units
269. Resource Economics and Policy. 3 units
270. Economics of Forestry. 3 units
271. Financial Management. 3 units
272. Business Policy. 3 units
273. Economics and Environmental Quality. 3 units
281. Forest Management. 3 units
283. Fire Behavior and Use. 2 units
289. Interpretation of Aerial Photographs. 3 units
290. Wood Anatomy. 3 units
292. Microtechnique of Woody Tissue. 3 units
299. Special Studies in Forestry. Credits to be arranged
301-302. Advanced Studies in Forestry. Credits to be arranged
304. Atmospheric Turbulence and Diffusion. 3 units
305. Forest Tree Biochemistry. 3 units
306. Dynamics of Local Atmospheric Motion. 3 units
321. Phytopathological Technique in Forestry. 4 units
322. Microbiology of Forest Soils. 3 units
331. Toxicology of Insecticides. 3 units
332. Ecology of Forest Insects. 3 units, 4 units with laboratory
335. Entomological Research Techniques. 1 unit
340. Ecology and Land Use Planning. 3 units
341. Ecological Principles in Environmental Management. 3 units

342. Hydrologic Process. 3 units
344. Micrometeorology. 4 units
346. Seminar in Environmental Policy. 2 units
347-348. Natural Resource Ecology—Environmental Management Seminar. 1 unit
352. Theory and Applications of Linear Statistical Models. 3 units
353. Design and Analysis of Experiments. 3 units
354. Quantitative Analysis of Ecological and Environmental Systems. 3 units
357-358. Research in Forestry. Credits to be arranged
362. Forest Soil Physics. 3 units
364. Soil Classification and Mapping. 3 units
366. Forest Soil Fertility. 3 units
368. Field Seminars. Credits to be arranged
377. Seminar in Natural Resource Allocation and Efficiency. 2 units
378. Seminar in Forest Economics. 2 units
382. Legal Aspects of Forestry. 1 unit
385. Seminar in Forest Protection. 1 unit
386. Seminar in Forest Management. 1 unit
398. Timbers of the World. 2 units

Appendix

ENROLLMENT

Registered for the Master of Forestry Degree

Allen, David Leslie (B.Sc., University of Louisville). Louisville, Kentucky
Austin, John Towneley (B.S., Furman University). High Point, North Carolina
Bacon, David Gardner (B.A., Duke University). Washington, D.C.
Boli, Eugene Clark (B.S., Columbia College). Xenia, Ohio
Booser, Joanna (B.A., Swarthmore College). Middletown, Pennsylvania
Broili, Robert Thayer (B.A., University of North Carolina). Raleigh, North Carolina
Butler, Elizabeth Ann (B.S., Duke University). Colorado Springs, Colorado
Cannon, Philip Gregory (B.S., Oregon State University). Bethesda, Maryland
Cline, George Richard (Davis and Elkins College). Aliquippa, Pennsylvania
Cook, Jeffrey Odlin (B.S., University of Maine). Fairfield, Maine
Coyle, Peter Joseph, Jr. (A.B., Duke University). Port Washington, New York
Devers, Debra Kay (B.A., Wittenberg University). Richwood, Ohio
Dodd, William Harrison, Jr. (A.B., Dickinson College). Carlisle, Pennsylvania
Dull, Charles Walter (Bridgewater College). Alexandria, Virginia
Eby, James Robert (B.S., Ursinus College). Mohnton, Pennsylvania
Ellsworth, Burton Leslie (B.S., Elizabethtown College). Myerstown, Pennsylvania
Everest, Raymond John (Guilford College). Winston-Salem, North Carolina
Fleming, John Edwin (B.A., Gettysburg College). Penfield, New York
Geyer, Paul Bennett (B.A., Gettysburg College). Gettysburg, Pennsylvania
Globig, Jonathan Frederick (B.A., Johns Hopkins University). St. Louis, Missouri
Graham, Thomas deGraffenried (A.B., J.D., University of North Carolina). Durham, North Carolina
Hamilton, Rickey Allen (Lycoming College). Carlisle, Pennsylvania
Hartlage, James Lee (Marshall University). Portsmouth, Ohio
Hermann, Gary Bruce (Ohio University). Denville, New Jersey
Hooten, John Joseph (B.A., Auburn University). Chattanooga, Tennessee
Howard, Ethan Victor, III (B.S., University of New Hampshire). Manchester, New Hampshire
Howard, Theodore Edward (B.S., University of Maine). Dartmouth, Massachusetts
Johnson, Charles Thomas (Thiel College). Montgomery, Pennsylvania
Jolley, Robert Melvin, Jr. (Catawba College). Baltimore, Maryland
Karakash, John Thomas (B.A., Gettysburg College). Bethlehem, Pennsylvania
Kauffman, Bruce Wentland (Ohio University). Canton, Ohio
Keepers, Gene Norman (Baylor University). Houston, Texas
Kerr, Leigh Robinson (Mercer University). Ft. Lauderdale, Florida
Kincaid, Dan Burton (B.S.F., West Virginia University). Columbus, Ohio
King, Larry George (B.Sc., Albion College). Ft. Wayne, Indiana
Kulick, Sue Ann (Wittenberg University). Columbus, Ohio
Leatherman, David Allen (B.S., Marietta College). Columbus, Ohio

MacComb, Louise Leslie (B.A., Southern Methodist University). Houston, Texas
Marshall, Philip Thomas (B.A., Catawba College). Royal Center, Indiana
McNaull, James Neal (A.B., University of North Carolina; M.Div., Union Theological Seminary). Durham, North Carolina
Mead, Delbert Ray (B.S., Albright College). Montrose, Pennsylvania
Metes, Nicholas Stefan (B.A., Miami University). Jackson Heights, New York
Moul, Robert Lawrence (Elizabethtown College). Spring Grove, Pennsylvania
Napier, John Grimsley (A.B., Duke University). Burlington, North Carolina
Nelson, Larry Robert (Ohio University). Canton, Ohio
Nettleton, Wesley Allen (B.S., Stetson University). Guilford, Connecticut
Oakman, Mark Whipple (Wittenberg University). Manchester, Connecticut
Owston, Robert David (B.A., Thiel College). Jamestown, Pennsylvania
Pegel, Robert Louis (Albright College). Philadelphia, Pennsylvania
Peifer, Arthur Lee (B.S., Elizabethtown College). Elizabethville, Pennsylvania
Peiffer, Gary Richard (Elizabethtown College). Locust Valley, New York
Peterson, Mark David (B.A., Clinch Valley College of the University of Virginia). Big Stone Gap, Virginia
Pfortner, Raymond George (B.S., Yale University). Woodcliff Lake, New Jersey
Pilling, Chad Burgess (B.A., Gettysburg College). Devon, Pennsylvania
Pritchard, David Thomas (B.S., Duke University). Waynesburg, Pennsylvania
Rabbetts, John Nicholas (Moravian College). Glenolden, Pennsylvania
Rocap, John Benjamin (Gettysburg College). Millville, New Jersey
Schlenker, James Wallace (B.S., Muhlenberg College). Silverdale, Pennsylvania
Schweitzer, Daniel Jay (Denison University). Canton, Ohio
Seiler, Gary Iorwerth (B.S., Albright College). Reading, Pennsylvania
Shay, Patrick Fred (B.S., Gettysburg College). Lebanon, Pennsylvania
Smith, John Winthrop (Furman University). Kingsport, Tennessee
Starrett, James Moore (B.A., Davidson College). Morganton, North Carolina
Stewart, Carol Frances (B.S., Mount Union College). Wexford, Pennsylvania
Stokes, Harry Currier (B.A., Duke University). Princeton, New Jersey
Swanson, James Thomas (B.A., Colgate University). Woodcliff Lake, New Jersey
Tait, Terrence Lee (B.S., Miami University). Dayton, Ohio
Taylor, Helen Jean (B.A., Duke University). Pittsburgh, Pennsylvania
Traylor, James Steen (B.S., Auburn University). Sardis, Alabama
Vasievich, Joseph Michael (Franklin and Marshall College). Easton, Pennsylvania
Walton, Theodore Richard (B.S., Davis and Elkins College). Cherry Hill, New Jersey
Weaver, David Forrest (The College of William and Mary). Arlington, Virginia
Whitenight, Donald Keith (A.S., York College of Pennsylvania; B.S., West Virginia University). Danville, Pennsylvania
Woodall, Stephen Lamar (B.A., Duke University). Clayton, Georgia

Registered for the Doctor of Forestry Degree

Douglass, Ross Swarens (B.S., North Carolina State University; M.F., Duke University). Raleigh, North Carolina

Students in the Department of Forestry in the Graduate School

Baldwin, Virgil Clark (B.S., University of Utah; M.S., Colorado State University). Salt Lake City, Utah
Barnard, Edwin Livingston (B.S., University of Vermont). Shoreham, Vermont
Bates, Maynard Edwin (B.A., Ohio University; M.S., Rutgers University). Millersburg, Ohio
Blake, Peter Newell (B.A., University of Michigan). Berwyn, Pennsylvania
Blakeslee, George M., Jr. (B.S., Albright College; M.F., Duke University). Durham, North Carolina
Bropleh, Patrick Doe (B.Sc., University of Liberia; M.F., Oregon State University). Monrovia, Liberia
Cheeseman, John McPherson (B.S., Duke University). Hudson, Ohio
Chung, Hsu Ho (B.S., National Taiwan University). Taiwan, China
Cole, Alexander Beryl (B.S., M.S., University of Missouri). Durham, North Carolina
Cordell, Charles Edward (B.S., N. C. State University; M.F., Duke University). Asheville, North Carolina
Crouse, Barry W. (B.S., Rutgers University; M.S., University of Maine). Rochester, New York

Duda, Alfred Michael (B.S., Boston College). Pittsfield, Massachusetts

Graham, William Alexander, II (A.B., J.D., University of North Carolina). Durham, North Carolina

Harms, Jan Christopher (B.S., University of Idaho; M.F., Duke University). Homewood, Illinois

Liljequist, Laura Ann (A.B., Marietta College). St. Albans, West Virginia

Lorimer, Craig Gordon (B.A., Colby College). North Windham, Maine

Methven, Ian Robert (B.Sc.F., University of New Brunswick). Fredricton, New Brunswick, Canada

Morgan, William Floyd, II (B.S., University of Illinois; M.F., Duke University). Normal, Illinois

Mowry, Fred Lear (B.S., Syracuse University). Syracuse, New York

Olmsted, Ingrid Christene (B.S., Brandeis University). Acton, Massachusetts

Péch, Gyula (B.S.F., University of British Columbia; M.F., Yale University; M.Sc., University of Guelph). Ottawa, Ontario, Canada

Schabel, Hans Georg (B.S., M.S., University of Freiburg). Honigwiesenstr, Germany

Shoulders, Eugene (B.S.F., West Virginia; M.F., Louisiana State University). Pineville, Louisiana

Sims, Herbert Percival (B.S.F., University of Britsh Columbia; M.S., Yale University). Winnipeg, Manitoba, Canada

Stubbs, Jack (B.S., Michigan State University; M.F., University of Minnesota). Blacksburg, Virginia

Watt, James Alan (B.S., University of Sydney; M.F., Duke University). Wyong, Australia

DEGREES CONFERRED 1971-72

Master of Forestry

Davison, Laird Allan
Edeburn, Judson Dunwoody
Howell, Fred Carlton
Lubs, John A.
Pierce, Thomas H.
Place, Michael Edward
Remorenko, William B., Jr.
Schnabel, Douglas Paul
Sharma, Eka Raj

Master of Science

Gresham, Charles Arthur

Doctor of Forestry

Swift, Lloyd Wesley, Jr. (B.S., New York State College of Forestry; M.S., North Carolina State University). Dissertation: "Effect of Forest Cover and Mountain Physiography on the Radiant Energy Balance"

Doctor of Philosophy

Sites, William Horace (B.A., Catawba College; M.F., Duke University). Dissertation: "The Infection Biology of **Urnula Craterium** (Schw.) Fr."

Photo credits:

Jimmy Wallace: cover; vii top left, bottom, right; 2; 5; 7 top right; 14; 18; 20 left, bottom right; 24 right; 26; 38

Thad Sparks: v, viii middle left, 7 bottom, 17, 24 left, 30, 36, 41

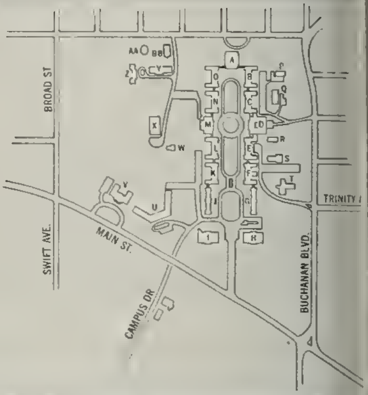
Carolyn H. Vaughan: viii, 10, 20 top right, 29

John Karakash: 7 top left, 22, 33, 34, 41

MAP OF DUKE UNIVERSITY

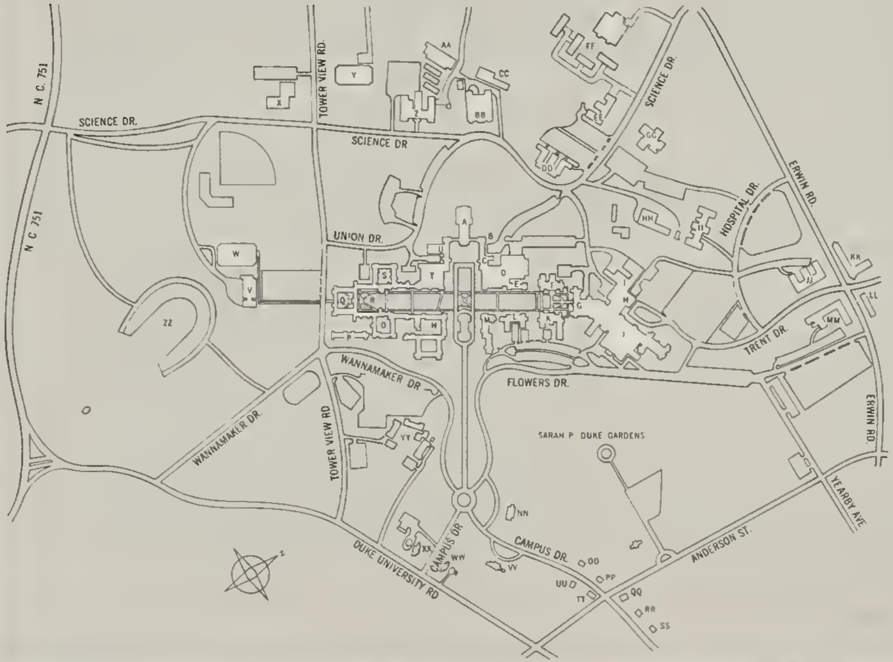
East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laborator
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanaline H. Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Program
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



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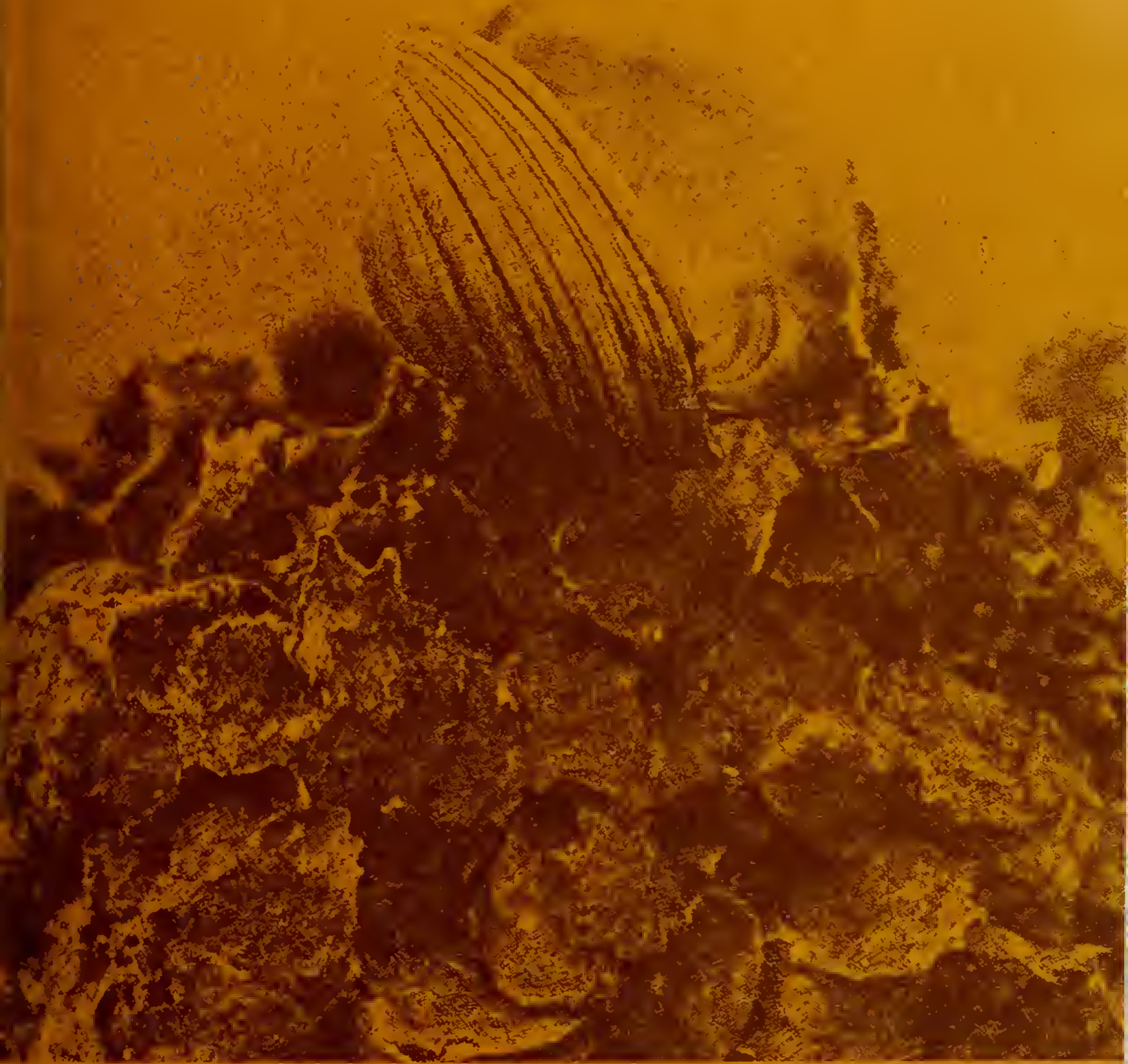
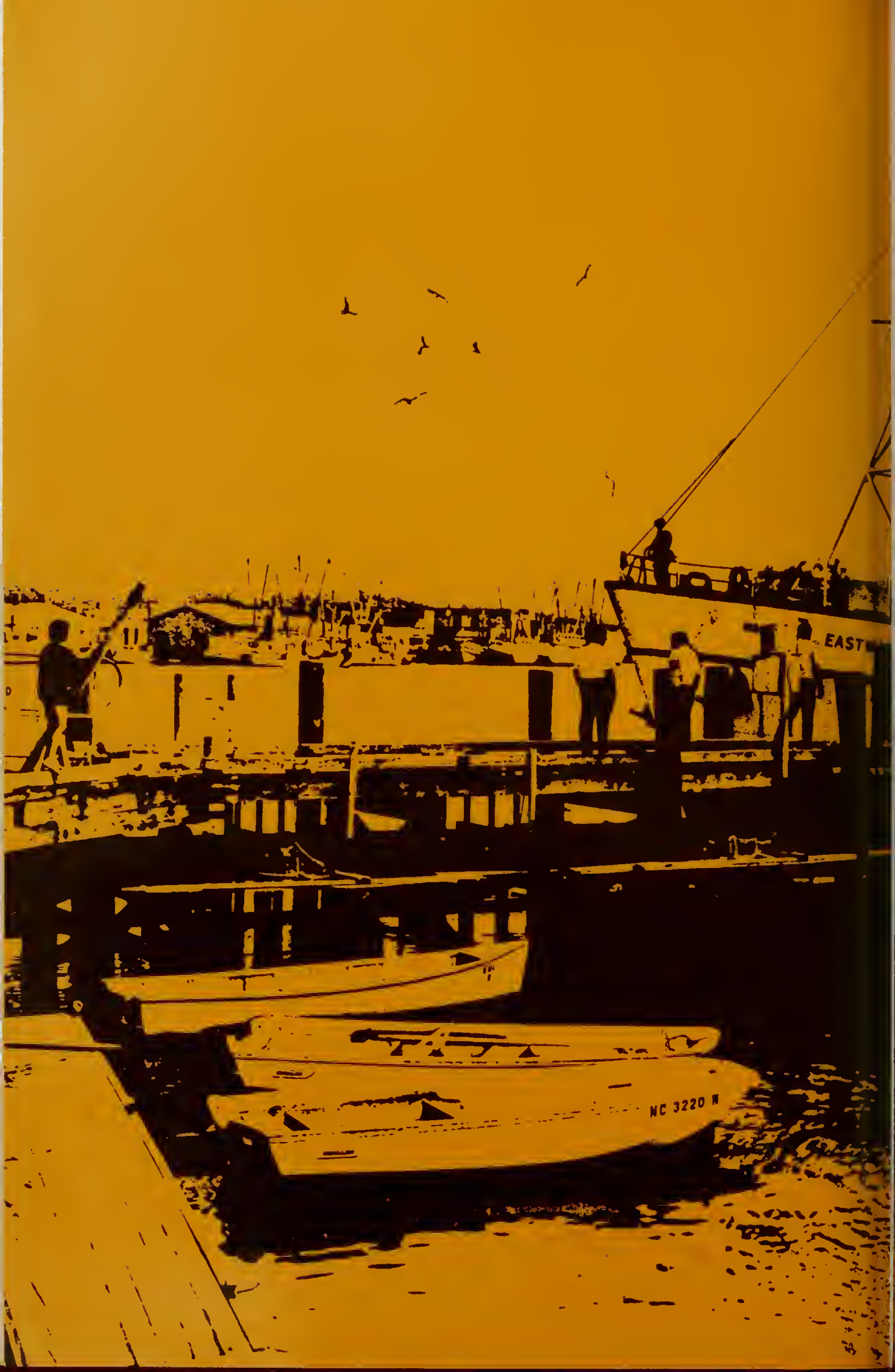


Bulletin of Duke University 1973-1974

Marine Laboratory
Beaufort, North Carolina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Bulletin of Duke University

Marine Laboratory

1973-1974

Beaufort, North Carolina 1972

Volume 45 October, 1972 Number 2

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1

General Information

The Laboratory

Through the efforts of Dr. A. S. Pearse, the Duke University Marine Laboratory was founded in 1938 on Pivers Island near the town of Beaufort, North Carolina. It was established initially to offer teacher training at the senior-graduate level, but research soon became an integral part of the program. Studies are currently being conducted in the fields of ecology, systematics, physiology, embryology, mycology, algology, and biological, chemical, geological, and physical oceanography. In addition to the graduate program, a newly established interdisciplinary program in the marine sciences now makes it possible for qualified undergraduates to spend the spring semester, 1973, at the Laboratory.

The Duke University Marine Laboratory presently occupies fifteen acres of the southern portion of Pivers Island; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Center for Menhaden Research encompasses the remainder of the island.

The physical plant consists of nineteen buildings including four dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, and six research buildings. The research laboratories and two dormitories are heated and air-conditioned thereby providing favorable conditions for year-round research.

Pivers Island is only 150 yards across the channel from the town of Beaufort. A bridge leads to U. S. Highway 70, so the Island is readily accessible by automobile. The only direct means of public transportation to Beaufort is by bus. The closest airport (served by Piedmont Airlines) is in New Bern, North Carolina, a distance of forty miles from Beaufort. Upon arrival at Beaufort, the Laboratory may be reached by taxi.

The Beaufort area is well known for its moderate climate during the summer. Air temperatures range from an average minimum of 70° F. to an average maximum of 86° F. There is a prevailing southwest breeze from the ocean during most of the summer. Water temperatures range from 22-29° C. in June and from 24-30° C. during August.

Students should bring clothes suitable for field work including a sun hat, tennis shoes, bathing suit, shorts, work gloves, and sunglasses.

There are ample opportunities for recreation in and around Beaufort for swimming, fishing, boating, and water-skiing. On campus there are recreational facilities for swimming, diving, shuffleboard, horseshoe pitching, volleyball, croquet, and table tennis.

2

Resources for Study

Flora and Fauna

Beaufort is approximately midway between Woods Hole, Massachusetts, and Miami, Florida, in an area within the range of both the northern and southern species of biota. The edge of the Gulf Stream system is about 35 miles offshore, and between it and the shore occasional reefs are found.

The Beaufort area is strategically located for biological research because of the richness of its flora and fauna, and the ease with which one may reach many diverse habitats. From the Laboratory, by boat or automobile, the ocean, Cape Lookout and the Outer Banks, Bogue and Core Sounds, Harker's Island, rivers, creeks, canals, mud flats, sand beaches, dunes, marshes, peat bogs, cypress swamps, bird islands and rookeries, and coastal forests are readily accessible. Long leaf pine, yaupon, and at least seven species of insectivorous plants (protected by law), including the Venus flytrap, grow in the region. A great variety of algae, both freshwater and marine, is also available for study. Common animals include the king crab, squid, shrimps, snails, clams, ctenophores, jellyfish, hydroids, sponges, polychaetes, sea urchins, starfish, brittle stars, sand dollars, skimmers, terns, gulls, herons, sea turtles, porpoises, and many different types of fish.

Research Interests

Much of the Marine Laboratory's early research consisted of determining distribution of plants and animals within the varying environments of the Beaufort estuary. With the addition of the Cooperative Oceanographic Program and the expansion of year-round activities, the general theme of the relationship of animals and plants to their environment has been broadened to include all segments of the estuarine and oceanic environments. Year-round research by resident staff, associates, visiting staff, and graduate students, generally falls into five broad disciplines: biochemistry, developmental biology, oceanography, physiology, and systematics-ecology.

Biochemistry. The primary emphasis in the biochemical studies involves research on the structure, function, and evolution of protein molecules. Proteins, especially those involved in the transport of molecular oxygen (hemoglobin, hemocyanin, chlorocruorin, and hemerythrin), are being isolated and their structural and functional properties elucidated. These studies are intended to illustrate how molecules have evolved and how they are involved in adaptive processes. From comparative studies one can illuminate structure-function relationships and derive data from phylogenetic significance. Studies of protein polymorphisms are also intended to illustrate gene flow among populations and offer insights into the adaptive strategies of marine organisms.

Developmental Biology. Much of the research in developmental biology deals with the culture of invertebrate larvae under controlled conditions in the laboratory, from hatching until the juvenile stages are reached. The availability of numerous larvae of known species, age, and stage of development has led to studies on the extent to which environmental factors within the marine environment affect rates of development, survival, and morphological abnormalities. In addition to studying the effects of natural environmental factors, research is under way to determine the effects of pollutants on larval development of marine Crustacea. The developmental biology program also includes studies on the physiology of crustacean larvae and the factors involved in regulation of molting, rate of development, and metamorphosis during larval development.

Oceanography. Within the Oceanography Program, research is being conducted to examine the physical and biological dynamics of marine ecosystems which are enriched by upwelling, including the Coastal Upwelling Ecosystems Analysis Program, a multi-university and multi-ship field experiment concentration on the northwest African coast upwelling. Other interests include the effect of metal and dissolved organic interactions on the biological productivity of the upwelling system and the measurement and modeling of carbon productivity of the ecosystems. Research is also under way on the rate of recycling of sewage sludge and the impact of sewage disposal on marine systems, the chemical form and biological reactivity of toxic and essential metals as determined by electron paramagnetic resonance, the ability of phytoplankton to synthesize coordination compounds that form complexes with metals and alter their biological reactivity, and the isolation and identification of hydroxamic acids suspected of being responsible for the biogenic conditioning of sea water.

Geological investigations are primarily concerned with processes of continental margin sedimentation, largely within the Carolina continental shelf slope and rise, and also in certain deep basins in the vicinity of the Bahama Banks. Studies are concerned with the origin of postdeath shell coloration and the sediment distribution and sedimentary processes on the Cape Hatteras sediment plume, characterization of the continental rise and the relative importance of bottom currents versus gravity flows in forming the rise, and delineation of individual sorting effects. Additional research involves sea floor topography, including contouring and diagramming continental and insular margins with emphasis on the distribution and patterns of submarine canyons. Geomorphic studies are also under way in support of investigations in the Caribbean.

Physiology. In the realm of physiological studies, one primary interest involves studies on the photobiology of organisms in the marine environment, with emphasis on behavioral orientation to light. This involves determining the responses of a variety of marine organisms (unicellular dinoflagellates, larval crustaceans, and fish) to light both in the natural environment as well as in the laboratory. Primary attention is on the identification of the light receptive pigments participating in the responses and the circadian rhythm of these responses. Accordingly phototaxis is used as a model system for studying the basic physiology of rhythms.

A second primary interest is in the mechanisms of ionic and osmotic regulation in marine plants and animals. This work involves a collaboration between the Department of Physiology and Pharmacology of Duke University and the Biochemistry Department of the University of Liege, Belgium. Euryhaline organisms can survive drastic fluctuations in salinity, and the internal adjustments made by these organisms may involve large changes in concentrations of amino acids and inorganic ions. One of our primary goals is to elucidate the metabolic processes which are responsible for these regulatory changes. Some marine organisms possess giant cells which offer unique opportunities for studying membrane transport processes. By internally perfusing these cells by means of micropipets we can control the internal ionic composition, hydrostatic pressure, and transmembrane voltage and current. At the same time we can measure the rates of solute and water movements across the cell surface, thus gaining insight into the mechanisms and functions of the transport processes.

Systematics-Ecology. Research in the systematics-ecology program involve studies on community structure, benthic algae, and distribution of certain marine species off the North Carolina coast.

The major objective of studies on community structure is to identify and understand the processes which result in the temporal and spatial patterns in species abundance in some subtidal, epibenthic communities. Changes in the adult populations are followed with mapping and photographic techniques. The approach is experimental to the extent that species can be removed or excluded from the community to assess their importance in community structure and function. An eventual goal is the development of a systems model incorporating the basic

community processes to provide the basis for predicting the deliberate or accidental effects of man's perturbations of these communities.

In part because the middle Atlantic coast is a meeting ground for the cool water species typical of northern shores and the warm water species of the Caribbean, studies include the determination of the distribution, phenology, and systematics of benthic algae off the coast of North Carolina. This work includes efforts to determine community structure and productivity in the different portions of Onslow Bay and to extend the studies north and south along the entire coast. A second aspect of the work is a descriptive study of the epiphytic algae which grow in the sounds on the blades of eel grass and other marine angiosperms.

Additional studies are being conducted to investigate the growth rates and development of suspension feeders in relation to temperature, size of the animals, concentration of suspended material, and the relative concentration of phytoplankton in suspension. These experiments involve natural seawater in a continuous flow system in which the concentration of phytoplankton can be monitored. The data should determine the conditions under which maximum energy transfer occurs between primary producers and a primary consumer, facilitating the future exploitation of scallops, oysters, and other similar species.

Research Facilities

Laboratory Equipment and Supplies. Visiting investigators may obtain research space throughout the year. Each research laboratory building is air-conditioned and equipped with running sea water through a hard rubber system. There are tanks, water tables, aquaria, autoclave, ovens, and plant presses. In addition to commonly used laboratory equipment, the following are available: two refrigerated centrifuges with multi-speed attachments, Beckman DU spectrophotometer, balances, pH meters, hoods, and constant temperature equipment. Each person is expected to supply his own optical equipment or other special apparatus needed. A list of equipment, chemicals, and glassware may be obtained upon request. The Laboratory also maintains a darkroom and well-equipped workshop.

New Research Facility. A three-story modern research laboratory was completed in early summer 1972. Each room is well lighted artificially and all exterior rooms also receive natural light. Most rooms have a view of the water surrounding some part of Pivers Island. All rooms are air-conditioned and heated electrically so that the temperature of each room can be controlled to suit the needs of the occupant. Hot and cold water, air, gas, and vacuum are available in most rooms. The non-metallic sea water system is especially designed to reduce silt and fouling. The general arrangement of rooms on each floor provides for a core of rooms in the center of the building which are for general use and research rooms of different sizes are at the periphery of the building. Although the rooms on all three floors were designed for special purposes, they may be used for research in a variety of disciplines.

Oceanographic Study. The 117.5-foot research vessel *Eastward* with a capacity for forty students on eight-hour cruises or fourteen students and staff on extended cruises may be used for oceanographic research. During the present year, the ship will operate in the Atlantic Ocean from the coast to the mid-Atlantic Ridge and south to Venezuela. It is outfitted with modern recording and collecting devices, and is available to investigators and teachers of graduate courses in marine sciences and their students. Application for ship time must be made in advance.

Inquiries should be addressed to the Oceanographic Program Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

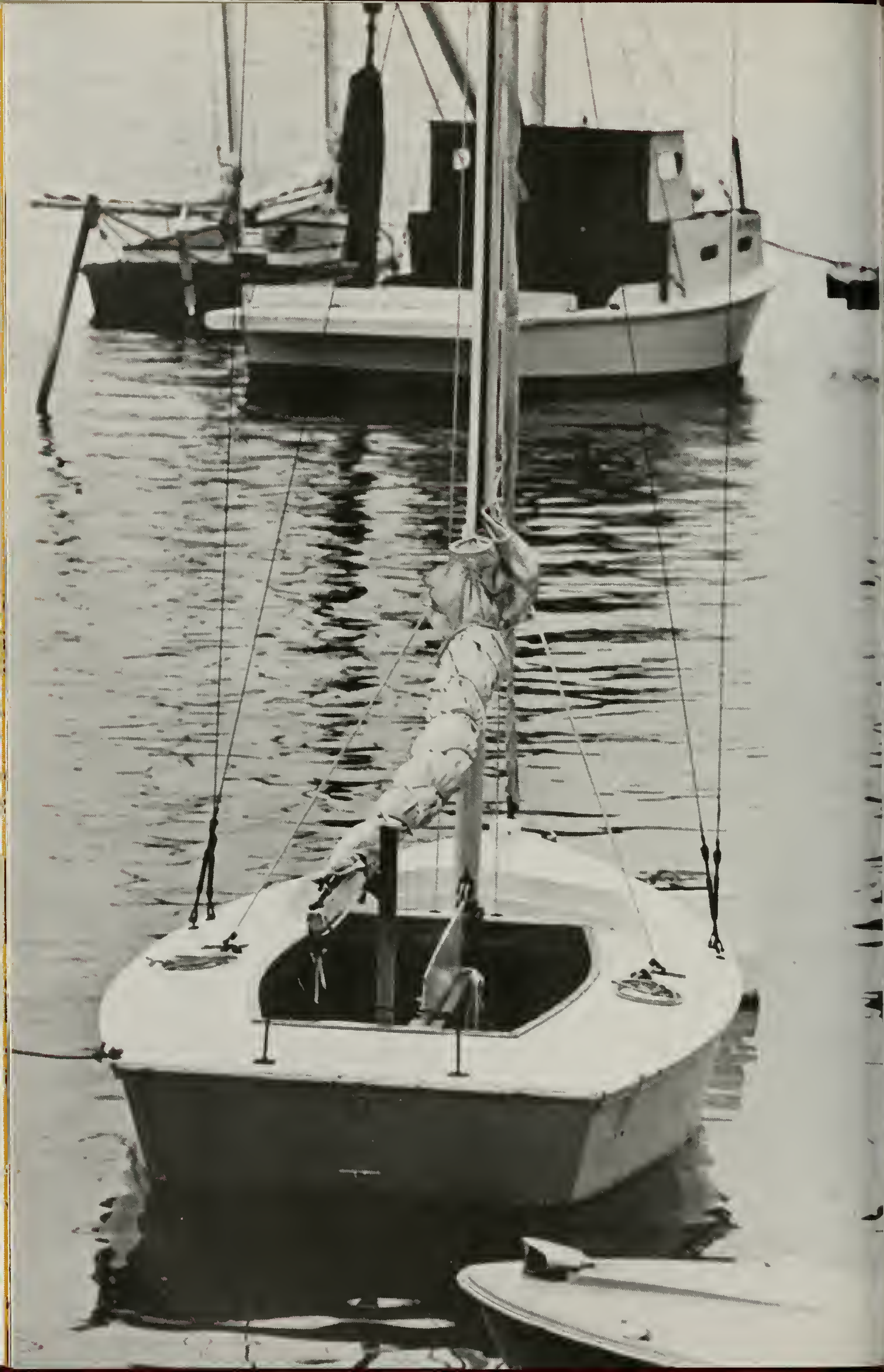
Collecting. Spades, shovels, sieves, and nets are provided without charge to assist the investigator with his collecting. A wide assortment of boats is available for various collecting activities. A complete schedule of boats and charges may be found in the section on Financial Information.

Library. The Pearse Memorial Library contains over 4,000 catalogued reference books and journals, 145 current journals, and 16,000 reprints. A microfilm library of graduate student theses based on research at the Laboratory, a microfilm reader, and a Xerox copier are also available. The librarian may obtain other materials by a special delivery system from the Perkins Library on the main campus or through the interlibrary loan service.

New Library-Auditorium. A library-auditorium is now under construction and should be completed by May or June 1973. It is air-conditioned and electrically heated, and will have ample stack space for present holdings and future acquisitions. The building will house a librarian's office, reading room, room for duplicating machines, a chart room, receiving room, a small kitchen, two seminar rooms, and two closed carrels. The auditorium will have a seating capacity of approximately 280; therefore, it will be suitable for lectures, seminars, symposia, and small regional or national meetings.

Reference Collections. A reference collection of approximately 1,500 different species of animals from coastal North Carolina is available to students and research personnel. Small collections of marine algae and vascular flora are also maintained, as well as a checklist by habitat of the common marine animals.

Computing Facilities. A PDP 11/20 digital computer is available for general student and staff use. It has an 8-K core memory bank and uses BASIC, a conventional, on-line language similar to FORTRAN. The input-output device is an ASR-33 teletype.



3

Financial Information

Tuition

Summer Terms. The following tuition charges for the summer registration and medical care:

1. Undergraduate students: $195.00 for each non-laboratory course; $260.00 for each undergraduate laboratory course; and $390.00 for each two-course (six-unit) program offered at the Duke Marine Laboratory.
2. Graduate students: $65.00 per unit; and for an undergraduate course, the tuition rate indicated in section 1 above is applicable.
3. Full-time teachers in elementary and secondary schools: one-half of the tuition charge specified in sections 1 and 2 above is applicable.

The Director of the Summer Session will notify the applicant of course approval. Tuition should then be paid promptly to the Director of Summer Session, Duke University, Durham, North Carolina 27706, to assure reservation in a course.

Spring Term. Tuition, at the rates indicated in the *Bulletin of Undergraduate Instruction*, will be paid at Duke University not later than the day of registration for the term.

Tuition must be received at least one week before the beginning of the term. Students who have not completed registration by 4:00 p.m. of the final day of registration of each term will be subject to a late registration fee.

Research Space

Individual research cubicles varying from 80 to 400 square feet are available at Duke University Marine Laboratory. The rental fee for research space is $1.00 per sq. ft. per month from May 1, 1973, to April 30, 1974.

No additional charges are made for research assistants occupying the same research space as the investigators. Graduate students from institutions other than

Duke University will be charged one-half the regular rate per person. Laboratory space rental does not apply to students participating in the Spring Undergraduate Program.

Inquiries and requests for space should be addressed to Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. Applications for the academic year are encouraged and will be acted upon shortly after they are received. All research applications for the summer of 1973 must be received by March 10, 1973.

Living Accommodations

Dormitories. Air-conditioned and a few non-air-conditioned dormitory rooms are available. Although every effort is made to limit two people per dormitory room, a few triple rooms may be needed to accommodate all individuals requiring dormitory space. Prospective students should indicate their preference for housing on the application for enrollment. It is impossible to guarantee that these preferences will be available in all cases.

Occupants must supply their own linens, blankets, and towels, but pillows will be furnished. All dormitory occupants will be on the board system during the summer terms. A key deposit of $1.00 will be charged each person occupying a dormitory room, with the deposit to be refunded at time of departure.

Dormitory charges which are payable at the Business Office of the Laboratory upon arrival are as follows:

Summer 1973

Non-air-conditioned double	$59.00 per term for each occupant
Air-conditioned double	$75.00 per term for each occupant
Air-conditioned triple	$54.00 per term for each occupant

Spring, 1974

Non-air-conditioned double	$195.00 per semester for each occupant
Air-conditioned double	$228.00 per semester for each occupant
Air-conditioned triple	$187.00 per semester for each occupant

Double rooms for married students are normally supplied only if both husband and wife are registered students at the Laboratory.

Beaufort Housing. Because Beaufort is located in a resort area, off-campus housing is very difficult to obtain and costs may range from $20.00 to $50.00 per week per person. Housing for married couples who are not both registered students at the Laboratory and couples with children in the Morehead City-Beaufort area is limited. A list of area realtors will be mailed to students upon request.

Dining Facilities

The Duke University Marine Laboratory Dining Hall will be open for two terms of the summer session. All dormitory residents are required to pay the full board fee of $130.00 per term. Students residing off-campus may purchase a full board meal ticket, weekly meal ticket, or individual meals. Individual meals are

the most expensive and full board is the least expensive on a meal-by-meal basis. Individual meal rates are as follows:

Breakfast	$ .90
Lunch	$1.50
Dinner	$2.00
Sunday Dinner	$2.30

Children under twelve will be charged one-half the adult rate.

The full board fee (at approximately a 12 percent savings from individual meals) provides for three meals per day, Monday through Saturday, and breakfast and moon dinner on Sunday. No credit will be allowed for meals that are missed, including those meals which may be missed as a result of research cruises in conjunction with course work. Meals will normally be provided on these cruises.

Research personnel and their families residing off-campus are urged to eat in the dining hall. Arrangements may be made for occasional meals if sufficient notice is given at the Business Office of the Laboratory.

The board fee is payable in full on or before the day of registration at the Business Office of the Laboratory.

Boat Rentals

The following boats are available at the Laboratory for collecting and instructional activities:

Boat Type	**Name**	**Charges (May 1, 1973 to April 30, 1974)**
55 ft. trawler	Beveridge*	$ 26.00 per hour $208.00 per day
39 ft. cabin Diesel powered	Venus*	$ 18.00 per hour $144.00 per day
17.5 ft. speedboat	Thunderbird	$ 14.00 per hour $112.00 per day
22.10 ft. open boat	Ocypode	$ 14.00 per hour $112.00 per day
Boston Whaler		$ 6.00 per hour $ 48.00 per day
Skiffs with outboard motors		$ 3.50 per hour $ 25.00 per day

*Crew required for safety of user and vessel.

These rates are intended to partially defray the cost of operating and maintaining these boats.

These boats may be scheduled by visiting researchers through the Maintenance Office; however, first priority must be given to classes when they are in session during the spring and summer terms.

If crew overtime is involved before or after their normal work day and any time Saturday or Sunday, the following charges will be made from January 1, 1973, to April 30, 1974: Master, $5.25 per hour; Winch Operator, $4.75 per hour; additional charge for overtime on Duke University holidays, $3.00 per hour.

Other Financial Information

Check Cashing. The banks in the Morehead City-Beaufort area have indicated that they will not cash personal checks for students unless they are guaranteed. Therefore, it is recommended that students at the Laboratory bring with them sufficient travellers checks, money orders, certified checks, or cash to cover expenses.

Other fees. Late registration fees will be charged in accordance with Duke University policy unless registration is completed and all fees paid by the last day of registration for the term.

Awards

Undergraduate. Undergraduate students who wish to be considered for appropriate financial awards should write to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

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Admission

Requirements and Procedures

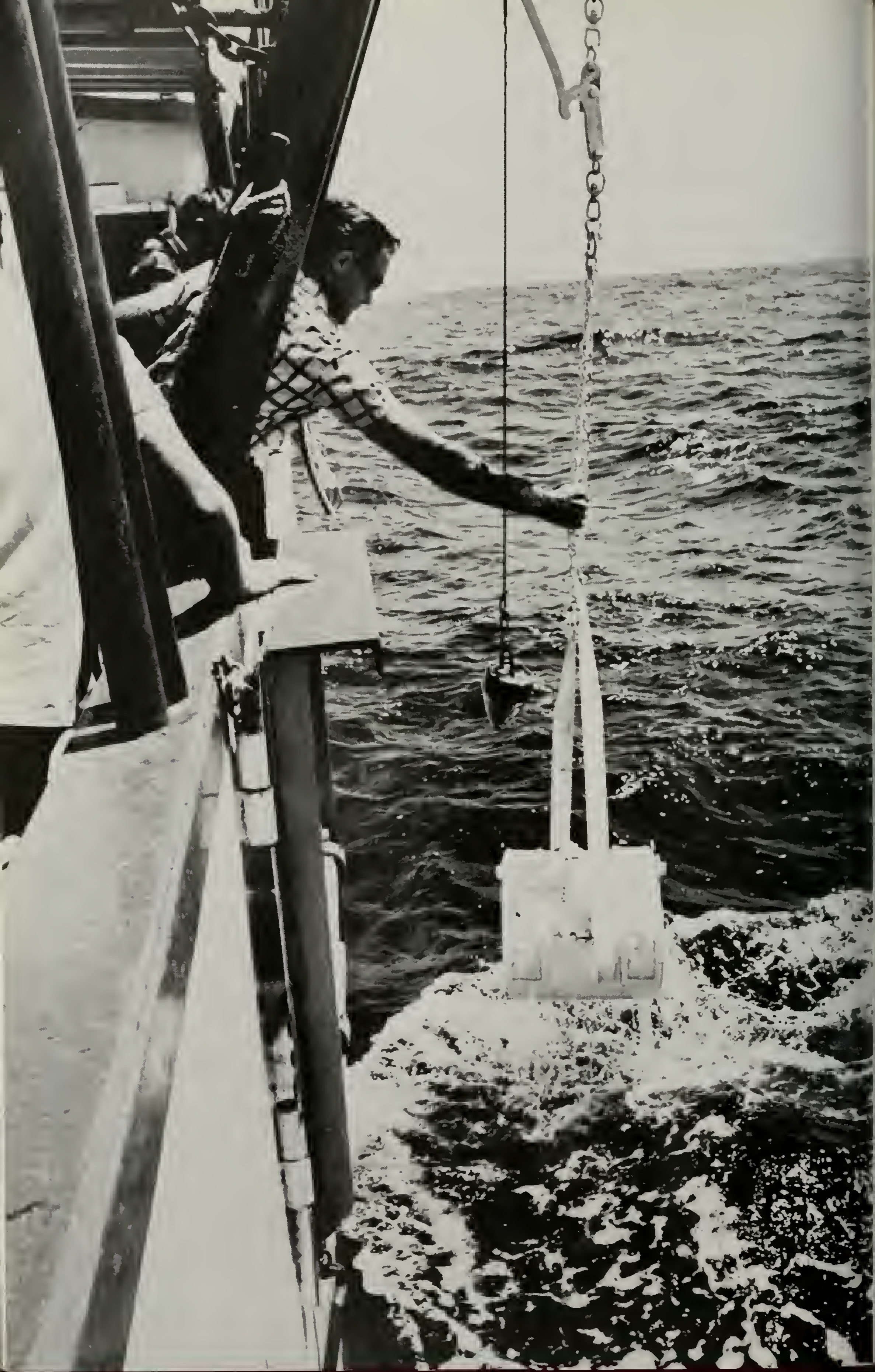
All students applying to the Duke Marine Laboratory should complete the appropriate application form at the back of this *Bulletin* and submit a transcript of their grades. Applicants will be considered without regard to race, color, religion, sex, or national origin. Students desiring a transfer of credit to their home institutions should request a course approval form for transfer of credit from the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Summer Terms. All courses offered at the Laboratory during the summer are intended for graduate students and senior undergraduate students. Applications should be submitted to the Director of the Laboratory as early as possible and not later than March 10. Late applicants will be admitted if space permits. After acceptance, payment of tuition is essential to assure reservation in a course.

Students wishing to apply summer credits toward an advanced degree at Duke University must, in addition to filling in the application blank, register with the Duke University Graduate School. Students, who have had adequate preparation and approval of their major professor may request space for independent or thesis research.

Students should plan on arriving between noon and 6:00 p.m., Sunday, June 17 (Term II), and Sunday, July 22 (Term III), at which times dormitory rooms will be ready for occupancy. Final registration will begin for all students at 8:00 a.m., June 18 (Term II) and 8:00 a.m., July 23 (Term III).

Spring Semester. An interdisciplinary program in the marine sciences is offered at the Duke Marine Laboratory for the spring semester. The program is open to qualified juniors and seniors from Duke and other colleges and universities. Applications are to be submitted by October 7, 1973, to the Director of the Laboratory. Each applicant should request two letters of recommendation, one of which must be from the director of undergraduate studies, or the equivalent, from the student's major department. Students will be notified of the action of the admission committee prior to preregistration for the spring semester.



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Courses of Instruction

Second Summer Term

June 18-July 20, 1973

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Marine Ecology. (Zoology 203). Ecological processes as exemplified by marine organisms. Lectures will cover environmental factors, intra- and inter-specific relationships, and community ecology. Class discussions on selected papers. Field projects utilizing current ecological methods. Practice in scientific writing. Use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. Two courses (6 graduate units). *Sutherland*

Comparative and Evolutionary Biochemistry. (Biochemistry or Zoology 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. Two courses (6 graduate units). *Sullivan*

Invertebrate Embryology. (Zoology 278.) Lectures, readings, and laboratory work dealing with rearing, development, and life history of invertebrates. Prerequisite: consent of the instructor. Two courses (6 graduate units). *Bookhout*

Introductory Marine Microbiology. (Botany 205.) The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. Two courses (6 graduate units). *Staff*

Physiological Ecology of Marine Animals. (Zoology 250.) A study of the physiology of marine and estuarine animals in relation to certain environmental factors (temperature, salinity, oxygen, and light). Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology and general zoology. Two courses (6 graduate units). *Forward*

Geological Oceanography. (Geology 205.) The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (This course is not open to students who have completed Geology 206.) Two courses (6 graduate units). *Pilkey*

Chemical Oceanography. (Zoology and Chemistry 240.) Chemistry and thermodynamics of multi-component systems and applications in the marine environment. Distribution and transport of chemical species will be described in terms of the processes that determine the chemical make-up of the oceans. Emphasis will be placed upon the quantitative evaluation of natural buffers in seawater, rates of reactions in seawater and at solid-liquid boundaries, gas exchange at the sea-air interface and the alteration of chemical equilibria by temperature, pressure, and ionic strength. The distribution of dissolved nutrients in the ocean will be discussed in terms of life cycles and the role nutrients play in photosynthesis. Problem solving will be used to a large extent for illustrating the principles of chemical oceanography. Prerequisites: chemistry and calculus. Two courses (6 graduate units). *Baier*

Research. (Zoology 354.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*

Third Summer Term

July 23-August 24, 1973

Independent Study. (Botany, Geology, or Zoology 191T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Marine Membrane Physiology. (Physiology 212.) Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course will include the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Laboratory work will deal with transport processes in gills and other epithelia, basic electrophysiology and synaptic transmission in mollusks, kidney function in fish, amino acid transport and metabolism in crustaceans, and the application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. Two courses (6 graduate units). *Gutknecht, Schoffeniels, Wachtel, and Staff*

Marine Invertebrate Zoology. (Zoology 274.) A study of invertebrate animals that occur in the Beaufort region. A number of field trips will be made to a variety of habitats to study and to collect animals in their natural environment. The structure and habits of living invertebrates, as well as their behavior under experimental conditions, will be studied in the laboratory. (Zoology 274 is not in-

tended for students who have had a graduate course in invertebrate zoology.) Prerequisite: a course in general zoology or general biology. Two courses (6 graduate units). *Staff*

Biological Oceanography. (Zoology 214.) The special adaptations of organisms for life in the sea and the impact of biological processes on the non-living components of the marine environment provide the core of the biological oceanography course. Among the ideas emphasized are the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in regulating the abundance, distribution, and community organization of marine organisms. A cruise on the *R/V Eastward* will investigate the physical and chemical processes which support the biological productivity of the continental shelf ecosystem. Prerequisites: chemical oceanography (offered second summer term) or permission of instructor. Two courses (6 graduate units). *Barber*

Marine Phycology. (Botany 211.) An introduction to marine algae—their identification, taxonomy, morphology, physiology, and ecology. Field trips are complemented by laboratory study, culturing, and preparation of herbarium material. Two courses (6 graduate units). *Searles*

Endocrinology of Marine Animals. (Zoology 277.) Evaluation of the role of the endocrine organs in the control of growth, regeneration, reproduction, metabolism, and other aspects of the physiology of marine animals, primarily invertebrates. Prerequisites: one course in physiology. Two courses (6 graduate units). *Hagadorn*

Introduction to Comparative Behavior. (Zoology 202.) Analysis of behavior, as revealed by physiological, evolutionary, and ecological study. Primary (but not exclusive) emphasis is placed upon marine groups. Lectures and laboratories. Prerequisite: one course in physiology. Two courses (6 graduate units). *Salmon*

Research. (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*

Spring Semester—Undergraduate Program

The semester program consists of the courses listed below. A student may apply during the spring to continue study at the Marine Laboratory during the summer either by participating in senior-graduate courses or by continuing the independent studies initiated during the spring term.

Man and the Marine Environment. (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment, with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisite: consent of instructor and director of undergraduate studies of student's major department. One course. *Costlow and Staff*

The Marine Environment. (Botany, Geology, or Zoology 169). The interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisite: introductory chemistry and consent of instructor and the appropriate director of undergraduate studies. One course. *Sutherland and Staff*

Physiology of Marine Organisms. (Zoology 150L.) Comparative physiology of marine animals including special ecological behavioral adaptations. Lectures and Laboratories. A student may not receive credit for both Zoology 150L and 250L. Prerequisite: introductory biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. One course. *Forward*

Seminar. (Zoology 296S.) Topics considered for 1973: Man's impact on biogeochemical cycles. Half-course. *Barber and Baier*; Recent research in the biochemistry and genetics of marine organisms. Half-course. *Sullivan*

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the director of undergraduate studies and the supervising instructor. One and a half courses. *Staff*

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Seminars

Academic Year 1971-72

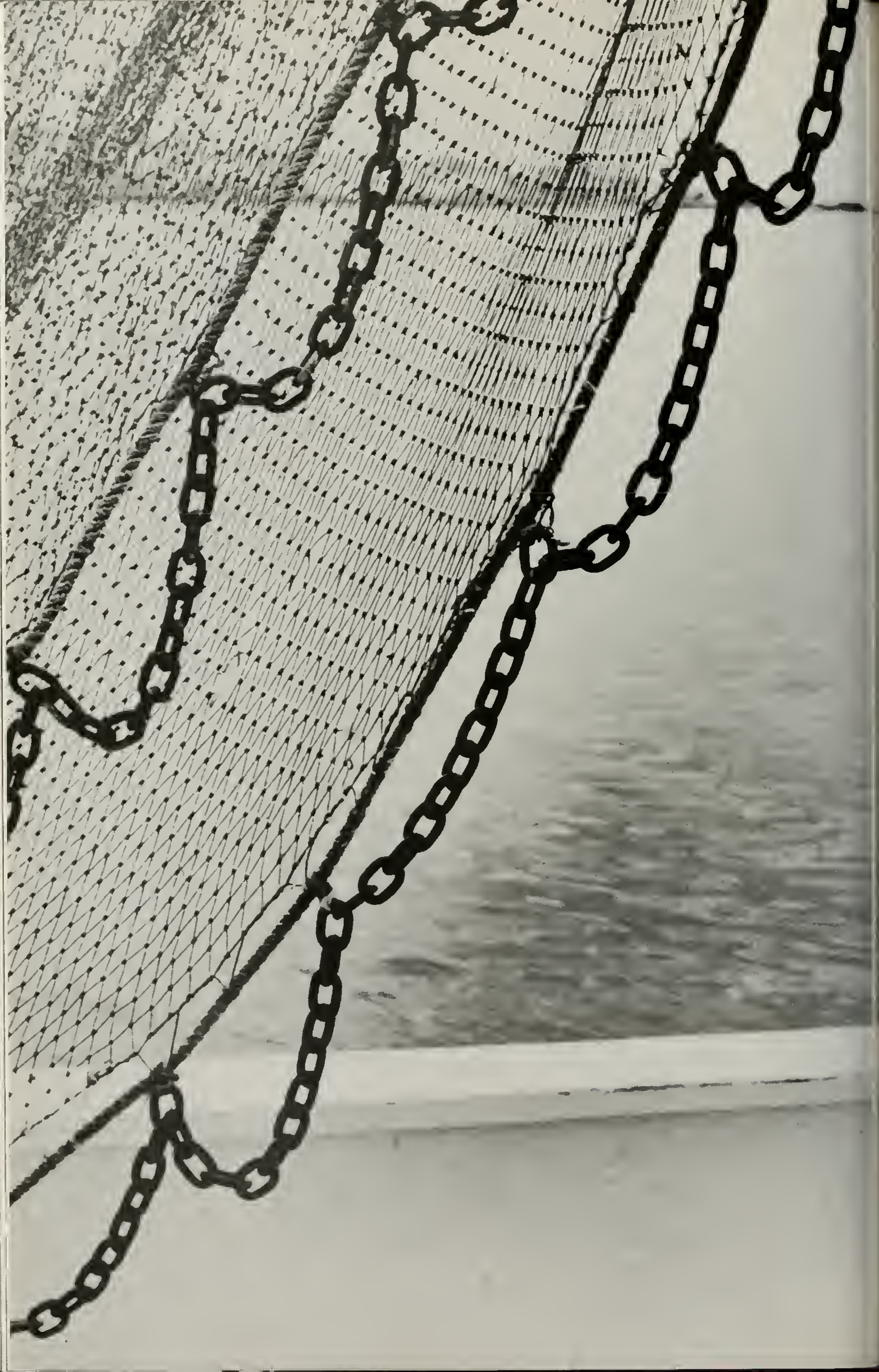
Date	Speaker	Topic
Sept. 3	Dr. Kendall W. Corbin Department of Ecology and Behavioral Biology University of Minnesota Minneapolis, Minnesota	Protein polymorphisms in avian populations of North America and New Guinea
Sept. 28	Dr. Zach M. Arnold Department of Paleontology University of California Berkeley, California	Cytology and life activities of the marine protozoan *Gromia oviformis* with comments on foraminiferan biology and techniques in intertidal protozoology
Oct. 17	Dr. John H. Tietjen Department of Biology City College of the City University of New York	Ecology and distribution of deep sea meiobenthos off North Carolina
Oct. 29	Dr. John T. Hardy Department of Botany University of Washington Seattle, Washington	Phytoneustron–Organisms of the air-water interface
Nov. 4	Dr. Guido Persoone Laboratorium voor Oecologie Biogeografie en Algemene Biologie Ghent, Belgium	*Artemia salina* as test-organism in technological culture problems
Nov. 11	Dr. James J. O'Brien Florida State University Tallahassee, Florida	Computer modeling of ocean circulation
Nov. 18	Dr. Bengt Owe Jansson Department of Environmental Engineering University of Florida Gainesville, Florida	Baltic Sea as an ecosystem

Dec. 1	Dr. Charles Peterson Department of Biological Sciences University of California Santa Barbara, California	Molluscan species diversity of Southern California lagoons
Dec. 2	Dr. William Blankley Biology Department Marine Biological Laboratory Woods Hole, Massachusetts	Role of light in Coccolith formation
Dec. 9	Dr. H. D. Holland Princeton University Princeton, New Jersey	Controls of the oxygen content of the atmosphere
Dec. 15	Dr. Henry Wilbur Society of Fellows University of Michigan Ann Arbor, Michigan	Competition, predation, and the structure of amphibian communities
Jan. 6	Dr. Rodger Baier University of Washington Seattle, Washington	Lead distribution in coastal waters
Jan. 20	Dr. Hans Fyhn University of Oslo Norway	Physiological adaptations to intertidal life in the Pacific Gooseneck Barnacle
Jan. 24	Dr. Iver W. Duedall Fisheries Research Board of Canada Bedford Institute Dartmouth, Nova Scotia	Some thoughts on the structure of water in seawater based on differential compressibility measurements
Feb. 10	Dr. Alfred Ebeling University of California Santa Barbara, California	Effects of the Santa Barbara oil spill on fish and macroplankton
Feb. 14	Dr. Paul Godfrey Department of Biology University of Massachusetts Amherst, Massachusetts	Maintenance of the outer banks
Feb. 15	Professor Unnsteinn Stefansson University of Reykjavik Reykjavik, Iceland	The function of the Office of Oceanography–UNESCO
Feb. 17	Dr. Robert T. Paine University of Washington Seattle, Washington	Experimentally based insights into the structure of marine intertidal communities
Feb. 22	Dr. Bruce J. Muga Department of Civil Engineering Duke University Durham, North Carolina	An introduction to some engineering problems of the marine environment

Feb. 25	Dr. Theodore Rice, Director National Marine Fisheries Service NOAA Department of Commerce Beaufort, North Carolina	Radioactivity in the marine environment
March 1	Dr. Thomas Duke Environmental Protection Agency Laboratory Gulf Breeze, Florida	Pesticides in the marine environment
March 9	Dr. Martin A. Buzas National Museum of Natural History Smithsonian Institution Washington, D.C.	Patterns of species diversity and their explanation
March 10	Dr. C. G. Bookhout Duke University Marine Lab. Beaufort, North Carolina	Specific aspects of pesticides and their effect on marine larvae
March 13	Dr. Gilbert T. Rowe Woods Hole Oceanographic Institution Woods Hole, Massachusetts	The Menzel-Craig, Gordon, *et al.*, controversy, or "Where does all the carbon go?" (As sung to the tune of "Where Have All the Flowers Gone?")
March 16	Dr. Irvine R. Hagadorn University of North Carolina Chapel Hill, North Carolina	Observations on the ultrastructure of normal and hormone-deficient spermatogenesis in *Hirudo*
April 3	Dr. Richard Barber, Director Cooperative Program in Biological Oceanography Duke University Marine Lab. Beaufort, North Carolina	Ocean dumping
April 5	Dr. John Ryther Woods Hole Oceanographic Institution Woods Hole, Massachusetts	Aquaculture and the constructive uses of sewerage as a possible nutritional source
April 26	Dr. Phyllis C. Bradbury Department of Zoology North Carolina State University Raleigh, North Carolina	Apostome ciliates, ubiquitous symbionts of Crustacea
May 2	Dr. Barry Ache Department of Biological Sciences Florida Atlantic University Boca Raton, Florida	Symbiosis: A tool for the analysis of behavioral competence in marine invertebrates

May 4	Professor M. S. Laverack, Director Gatty Marine Laboratory St. Andrews, Scotland	Sensory structure and physiology in lobsters
June 12	Professor Kjell Johansen University of Aarhus Aarhus, Denmark	Oxygen transport mechanisms in aquatic organisms
June 20	Dr. Hans Fyhn University of Oslo Oslo, Norway	Circulation, respiration, and water balance in the Pacific Gooseneck Barnacle
June 22	Dr. Kendall W. Corbin University of Minnesota Minneapolis, Minnesota	Protein polymorphisms in populations of New Guinea birds
June 27	Dr. Ralph A. Bradshaw Department of Biological Chemistry Washington University School of Medicine St. Louis, Missouri	Nerve growth factor: Structure, function, and genetic origin
June 27	Dr. Jane MacIsaac Dugdale Department of Oceanography University of Washington Seattle, Washington	Factors influencing inorganic nitrogen uptake in the sea
June 28	Dr. Dolores Blasco Department of Oceanography University of Washington Seattle, Washington	Influence of nitrite excretion by phytoplankton upon the primary nitrite maximum in the sea
June 29	Dr. Harold Atwood Ramsay Wright Zoological Laboratories Toronto, Ontario, Canada	Crustacean neuromuscular systems
July 4	Dr. Gordon Leversee Department of Biology Nasson College Springdale, Maine	Effects of water currents on morphology and feeding of the sea whip, *Leptogorgia*
July 6	Dr. Donald Hoss National Marine Fisheries Service NOAA Department of Commerce Beaufort, North Carolina	O_2 consumption and energy requirements of pinfish in Newport River Estuary
July 11	Dr. Kenneth Knight Head, Department of Entomology North Carolina State University Raleigh, North Carolina	Effects of ditching on salt marsh insect populations

July 13	Dr. Michael Salmon Department of Zoology University of Illinois Champaign, Illinois	Courtship in Fiddler Crabs
July 18	Professor Bruno Battaglia Universita di Padova Padova, Italy	Geographic and reproductive isolation in the marine Harpacticoid copepod, *Tisbe*
July 20	Dr. R. T. Paine University of Washington Seattle, Washington	Experimentally based insights into the structure of marine intertidal communities
July 25	Dr. Jan Kohlmeyer University of North Carolina Institute of Marine Sciences Morehead City, North Carolina	Parasite saprophytic and symbiotic fungi on marine algae
July 27	Dr. James Gooch Department of Biology Juniata College Huntingdon, Pennsylvania	A sampler of aquatic genetics: studies on Bryozoans, Gastropods, and Amphipods
August 1	Dr. Len Kirschner Washington State University Pullman, Washington	Kidney function and the origin of the vertebrates
August 3	Dr. Marit Christiansen University of Oslo Oslo, Norway	Zoogeographical studies on crabs in the Northeast Atlantic
August 8	Dr. William Blankley University of North Carolina Chapel Hill, North Carolina	Heterotrophic growth of Coccolithophorids
August 10	Dr. Charles Johnson Duke University Marine Lab. Beaufort, North Carolina	Protozoan parasites of blue crabs
August 15	Dr. John Gray Leeds University Wellcome Marine Laboratory Robin Hood's Bay, England	Marine pollution—Laboratory and field studies
August 17	Dr. Ralph Cavaliere Department of Biology Gettysburg College Gettysburg, Pennsylvania	Fungi live in the damndest places
August 22	Dr. William Bretz Duke University Marine Lab. Beaufort, North Carolina	Near-substrate water currents: their importance in behavior and filter feeding
August 24	Dr. Rodger Baier Duke University Marine Lab. Beaufort, North Carolina	Lead distribution in coastal waters



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1971-72

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Appendix

CALENDAR FOR SUMMER SESSION, 1973

Instruction begins—Term II, June 18
Term II ends—July 20

Instruction begins—Term III, July 23
Term III ends—August 24

ADMINISTRATION AND LABORATORY PERSONNEL

Advisory Committee

John D. Costlow, Ph.D., Director
Duke University Marine Laboratory

Donald J. Fluke, Ph.D., Chairman
Department of Zoology

John W. Gutknecht, Ph.D.
Department of Physiology and Pharmacology

R. L. Hill, Ph.D.
Department of Biochemistry

Sigfred A. Linderoth, Jr.
Department of Mechanical Engineering

Orrin H. Pilkey, Ph.D.
Department of Geology

Louis Quin, Ph.D., Chairman
Department of Chemistry

Richard B. Searles, Ph.D.
Department of Botany

Administrative Staff

Director

John D. Costlow
Professor of Zoology

Director of Cooperative Program in Biological Oceanography

Richard T. Barber
Associate Professor of Zoology and Botany

Business Manager

Larry L. Spalding

Maintenance Supervisor

Norris Hill

Marine Superintendent of Oceanographic Operations

John G. Newton

Assistant Marine Superintendent of Oceanographic Operations

Eric Nelson

Master of R/V EASTWARD

Ragnvald Sandoy

Information Specialist
Coastal Upwelling Ecosystems Analysis

Robert H. Warsing

Administrative Assistant

Craig Horne

Academic Staff

Rodger Baier, Ph.D.
Chemical oceanography

Richard T. Barber, Ph.D.
Biological oceanography

*William Blankley, Ph.D.
Phytoplankton systematist

C. G. Bookhout, Ph.D.
Marine invertebrate embryology and invertebrate zoology

John D. Costlow, Ph.D.
Marine invertebrate embryology and experimental zoology

Richard B. Forward, Ph.D.
Physiological ecology of marine animals

I. E. Gray, Ph.D., Professor Emeritus
Marine ecology and entomology

---

*Leave of absence, September 1, 1972, to August 31, 1973.

John Gutknecht, Ph.D.
Membrane physiology

†Irvine Hagadorn, Ph.D.
Endocrinology

†Orrin Pilkey, Ph.D.
Geological oceanography

†Michael Salmon, Ph.D.
Behavior of marine animals

†Richard B. Searles, Ph.D.
Marine phycology

J. Bolling Sullivan, Ph.D.
Comparative and evolutionary biochemistry

John Sutherland, Ph.D.
Marine ecology

†Summer only.

Research

Rodger Baier, Ph.D.
Duke University Marine Laboratory
Staff
Trace metal studies in coastal waters.

Richard Barber, Ph.D.
Duke University Marine Laboratory
Staff
Coastal upwelling ecosystems analysis; biogeochemical cycling of organic matter and metals; and phytoplankton nutrition and organometallic complexes in the sea.

William Blankley, Ph.D.
Duke University Marine Laboratory
Staff
Phytoplankton systematics.

C. G. Bookhout, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development of estuarine and oceanic Crustacea.

Celia Bonaventura, Ph.D.
Duke University Marine Laboratory
Research Associate
Photochemical reactions of protein molecules.

Joseph Bonaventura, Ph.D.
Duke University Marine Laboratory
Associate, Department of Biochemistry, Duke University
Protein structure and function.

William Bretz, Ph.D.
Duke University Marine Laboratory
Research Associate
The hydrodynamic relationships between sessile and benthic marine organisms and their ambient water currents.

Marit Christiansen, Ph.D.
University of Oslo
Oslo, Norway
Nordic Fellow
Salinity and temperature effects on crab larvae, and effects of the larvicide ZR 515 on the development of crab larvae in various salinities and temperatures.

John D. Costlow, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development and distribution of estuarine and oceanic Crustacea; the effect of cyclic temperature on larvae of marine invertebrates: and studies on molting and growth in larval and adult barnacles and larval decapods.

Richard Forward, Ph.D.
Duke University Marine Laboratory
Staff
Investigations of the photobiology of Dinoflagellates and larval crustaceans.

Hans Fyhn, cand. real.
University of Oslo
Oslo, Norway
Research Associate
Osmoregulation in marine invertebrates.

Unni Fyhn, cand. real.
University of Oslo
Oslo, Norway
Research Associate
Cement glands in barnacles; protein polymorphisms in fish.

I. E. Gray, Ph.D., Professor Emeritus
Duke University Marine Laboratory
Director, Reference Museum
Preparation of an Atlas of marine benthic organisms.

John Gutknecht, Ph.D.
Duke University Marine Laboratory
Staff
Membrane physiology: Permeability and transport properties of marine algae and phospholipid bilayer membranes.

Susan Huntsman, Ph.D.
Duke University Marine Laboratory
Research Associate
Phytoplankton nutrition and organometallic complexes in the sea.

Charles Johnson, Ph.D.
Duke University Marine Laboratory
Research Associate
Life history studies of protozoan parasites in the blue crab, *Callinectes sapidus.*

William Kirby-Smith, Ph.D.
Duke University Marine Laboratory
Curator, Reference Museum

John Newton, B.A.
Duke University Marine Laboratory
Staff
Marine biological Atlas of North Carolina; seaward extension of Washington and Wilmington submarine canyons on the lower continental rise; eastern terminus of Hudson Canyon in the divide between Sohm and Hatteras Abyssal Plains; and physiographic diagram of the North Western Atlantic Ocean.

Genevieve Payen, A.R., CNRS
Laboratoire d'Evolution de la Faculte des Sciences de Paris
Paris, France

Research Associate
Control of sexual differentiation in Crustacea.

Orrin Pilkey, Ph.D.
Department of Geology
Duke University
Staff
Eastern terminus of Hudson Canyon in the divide Sohm and Hatteras Abyssal Plains; seaward extensions of Washington and Wilmington submarine canyons on the lower continental rise; turbidity flow mapping, Hispaniola abyssal plain; contour current and North Carolina rise formation.

Ernest Schoffeniels, Ph.D.
Universite de Liege
Laboratoire de Biochimie
Liege, Belgium
Visiting Professor
Cell volume regulation and amino acids metabolism in Crustacea.

Richard B. Searles, Ph.D.
Department of Botany
Duke University
Staff
Study of the benthic communities on the continental shelf using facilities of R/V EASTWARD; and a descriptive study of the epiphytic algae which grow in the sounds on the blades of eel grass and other marine angiosperms.

J. Bolling Sullivan, Ph.D.
Duke University Marine Laboratory
Staff
Comparative aspects of protein chemistry.

John P. Sutherland, Ph.D.
Duke University Marine Laboratory
Staff
Experimental studies on the dynamics of fouling communities

GRADUATE STUDENTS ENGAGED IN THESIS RESEARCH

Gilbert Anderson, B.S.
Department of Zoology
Duke University
Larval development in decapods.

Lesley Ann Barling, B.S.
Department of Zoology
Duke University
Relationship between *Neosimnia* and *Leptogorgia*

Mary Berry, B.S.
Department of Zoology
Duke University
Biochemical changes during shrimp development.

Robert Dean, B.A.
Department of Zoology
Duke University
Microbiological investigation of marine wood-boring molluscs.

Humberto Diaz, Lic. Biol.
Department of Zoology
Duke University
Studies on settlement and recruitment process in the mole crab, *Emerita talpoida*.

Thomas Fisher, B.A.
Department of Zoology
Duke University
Physiology of fouling organisms.

Jean-Francois Gerard, M.S.
Laboratory of Biochemistry
University of Liege
Liege, Belgium
Cellular volume regulation in the axone of the blue crab, *Callinectes sapidus*.

James Graves, B.S.
Department of Physiology and Pharmacology
Duke University Medical Center
Membrane transport processes in marine algae.

Evelyn B. Haines, B.S.
Department of Zoology
Duke University
Metabolic processes, nutrient distribution, and productivity in the waters of the continental shelf.

David Harame, B.S.
Department of Zoology
Duke University
Endocrine mechanisms in barnacle larvae.

David Hastings, B.A.
Department of Physiology and Pharmacology
Duke University Medical Center
Membrane transport processes in marine algae.

Burton Jones, B.S.
Department of Zoology
Duke University
Modeling of phytoplankton growth in nutrient-rich, unconditioned seawater.

Ronald Karlson, B.A.
Department of Zoology
Duke University
Nudibranch-hydroid interactions.

Freddy Losada, Lic. Biol.
Department of Zoology
Duke University
Aspects of growth and shell deposition in barnacles.

Sharon Smith, M.A.
Department of Zoology
Duke University
Thermal effects and plankton ecology.

Research Technicians

Michael Bradley, M.S.
William Davis, M.A.
John Dean, B.S.
Clarke Edwards, M.S.
Teri L. Herbert, B.S.
Sally Herring
Doris King, B.A.
James L. Klein, B.S.
Rebecca C. Piver
Sandra E. Woods, Ph.D.
Virginia Young, M.S.

SUPPORT STAFF

David L. Bunting
Senior Draftsman

James Chadwick
Housekeeper

Claudia O. Davis
Housekeeper

Clifton Davis
Carpenter

Helen Davis
Housekeeper

James M. Davis
Oceanographic Party Chief

Janet A. Ely
Administrative Secretary

Annie C. Fulford
Housekeeper

Dianne Gagnon
Accounting Clerk

Olive C. Godette
Senior Housekeeper

Horace Holland
Mechanic

James B. Hunnings
Custodian of Records and
Relief Master/Mate

Dorothy T. Johnson
Secretary

Mary Fond Jones
Secretary

Fred L. Kelly
Oceanographic Party Chief

Mamre M. Knight
Clerk Typist

George Lockhart
Light Equipment Operator

Estelle G. Merrell
Administrative Secretary

I. Grayden Moore
Carpenter

Herman Myers
Senior Refrigeration and
Air Conditioning Mechanic

George A. Newton
Oceanographic Party Chief

Margaret H. Peoples
Scientific Illustrator

Jo Ann Rivera
Secretary

George S. Robinson
Painter

Ruthella Rozier
Senior Clerk Typist

Richard R. Seely
Electronic Technician

Sylvia Springle
Secretary

Florence M. Taylor
Senior Sponsored Programs Clerk

Sophia D. Turnage
Material Control Clerk

Jean S. Williams
Library Assistant

James L. Willis
Boat Serviceman/Operator

R/V EASTWARD Personnel

Ragnvald P. Sandoy, Master
Harold W. Yeomans, Chief Mate
Curtis Nelson, Chief Engineer
William A. Davis, First Assistant Engineer
Harold G. Willis, Second Assistant Engineer
John B. Weeks, Jr., Relief Mate
Tennie Davis, Oiler
Clyde R. Everett, Seaman/Messman
Delmas L. Guthrie, Seaman
Edwin M. Rose, Seaman
Curtis A. Oden, Bosun
Benjamin H. Smith, Cook/Messman
Howard L. Wilson, Steward/Cook
P. Jesse Tillett, Seaman
James K. Dixon, Wiper

APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY SUMMER SESSION

Name..............................
Please Print

Date..............................

Reserve a place for me in the following course(s): (Only one 6-unit per term will be permitted; first and second choices may be indicated.) Each applicant should submit a transcript of grades to the Director.

SECOND TERM:

Course Number	**Title of Course**
....	....
....	....

THIRD TERM:

Course Number	**Title of Course**
....	....
....	....

Fees will be paid by: Self......... Other.......................................

Reserve a room: TERM II........................ TERM III.......................

Attended Summer Sessions at Duke University Marine Laboratory: Yes........ No........

Years ....

Request grade(s) be applied toward:

Undergraduate credits..............

Graduate credits..................

General (unclassified)..............

If teacher: List name and address

of school.......................

If college student, list:

Undergraduate........ Year........

Graduate............. Year........

Name and address of School:

....

....

Married........... Single...........

Colleges and/or universities attended and degrees:	Degree
....	....
....	....

Street Address............................ Rural Route or P. O. Box...........

Post Office................................ State................. Zip.........

Signature..................................

Mail to: Director

Duke University Marine Laboratory
Beaufort, North Carolina 28516

APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY SPRING SEMESTER MARINE SCIENCES PROGRAM FOR UNDERGRADUATES

Please type or print. Date...............................

1. Name ....
last first middle

2. Social Security Number......................... Sex: Male........ Female........

3. Date of Birth: Month...................... Day............. Year..............

4. A. Current mailing address:

City................................. State................ ZIP...........

Area Code............... Telephone Number................

B. Permanent or home address:

City................................. State................ ZIP...........

Area Code............... Telephone Number................

5. A. Present marital status: Single.......... Married..........

If applicable, give number of dependent children..........

B. Name and address of next of kin:

Name.. Relationship..................

Address......................City............. State.......... ZIP.......

Area Code............... Telephone Number................

6. A. Duke University undergraduate student:

Trinity College.........

Woman's College.........

Engineering.........

B. Special student desiring transfer credit:

Name and address of home institution

....

City................................. State................ ZIP...........

C. Major department.. Class............

continued on reverse side

7. The following persons have been requested to mail letters of recommendation to the Director of the Laboratory:

A. Name.................................... Position.....................

....

City................................ State................ ZIP...........

Area Code............... Telephone Number................

B. Name.................................... Position.....................

....

City................................ State................ ZIP...........

Area Code............... Telephone Number................

8. Transcript(s) will be sent by the following institution(s):

....

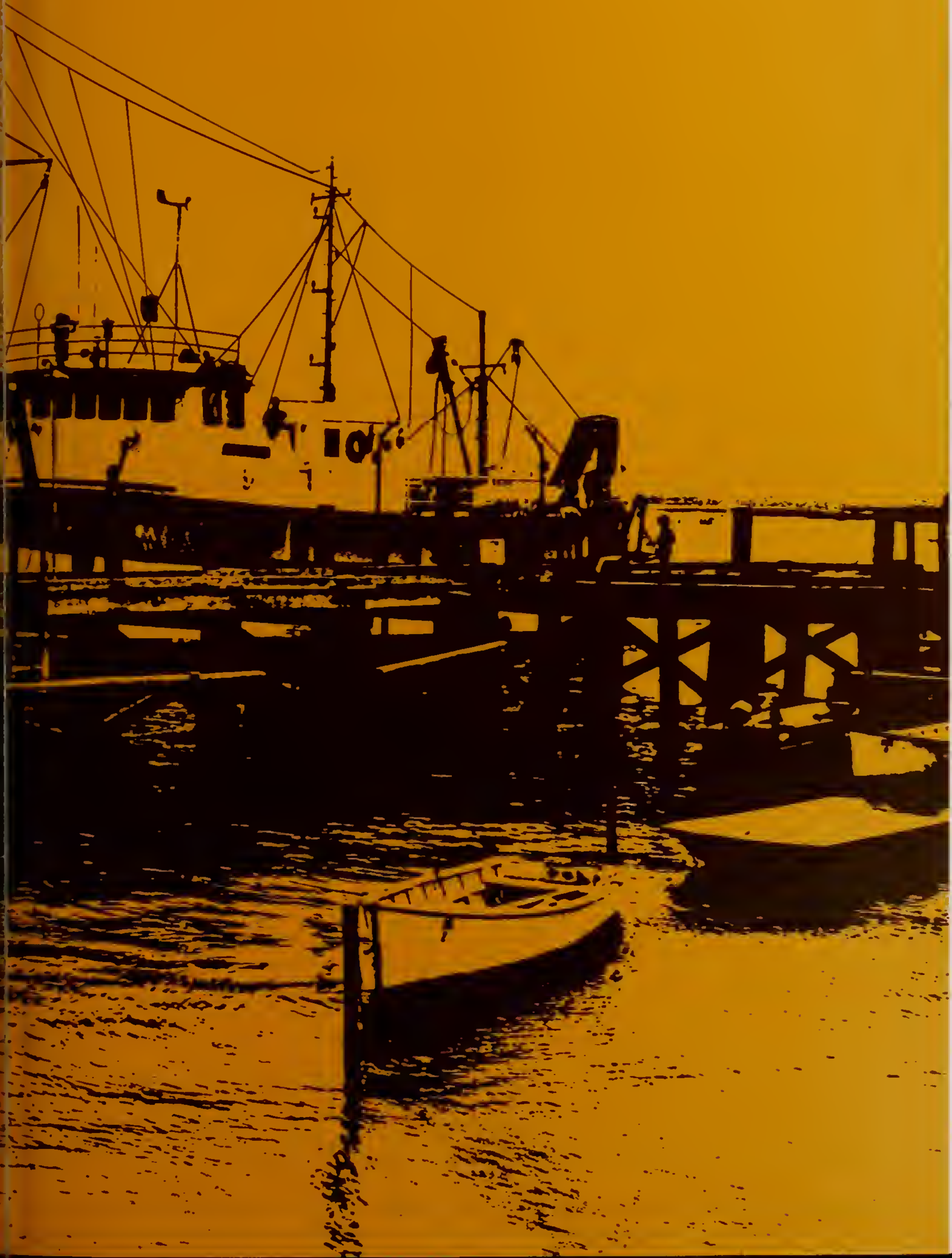
....

....

9. Have you ever been placed on probation or suspended or dismissed from any school?

Yes........ No........ (If yes, please explain below.)

Mail application to: Director
Duke University Marine Laboratory
Beaufort, North Carolina 28516



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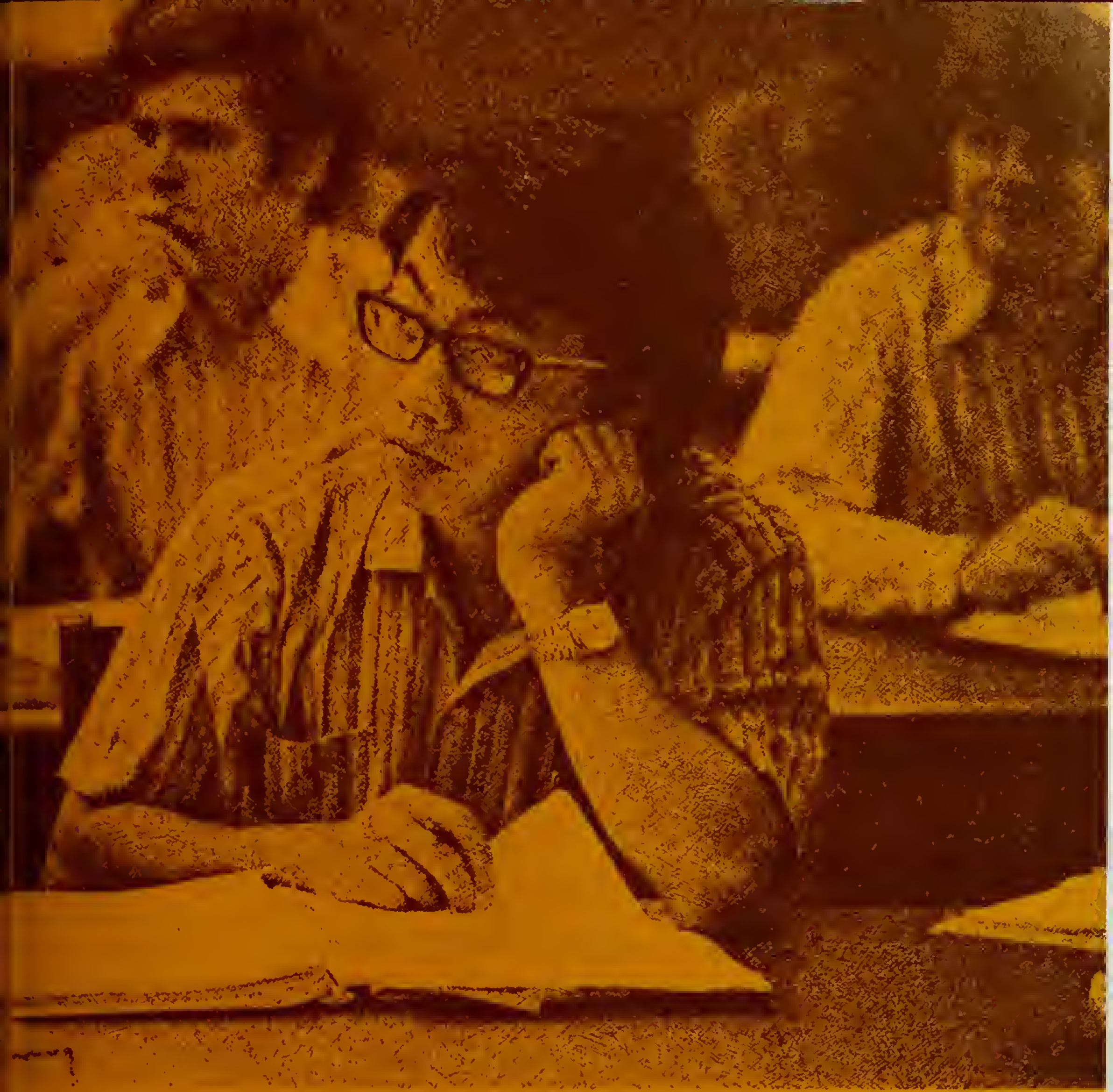

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The Graduate School of Business Administration

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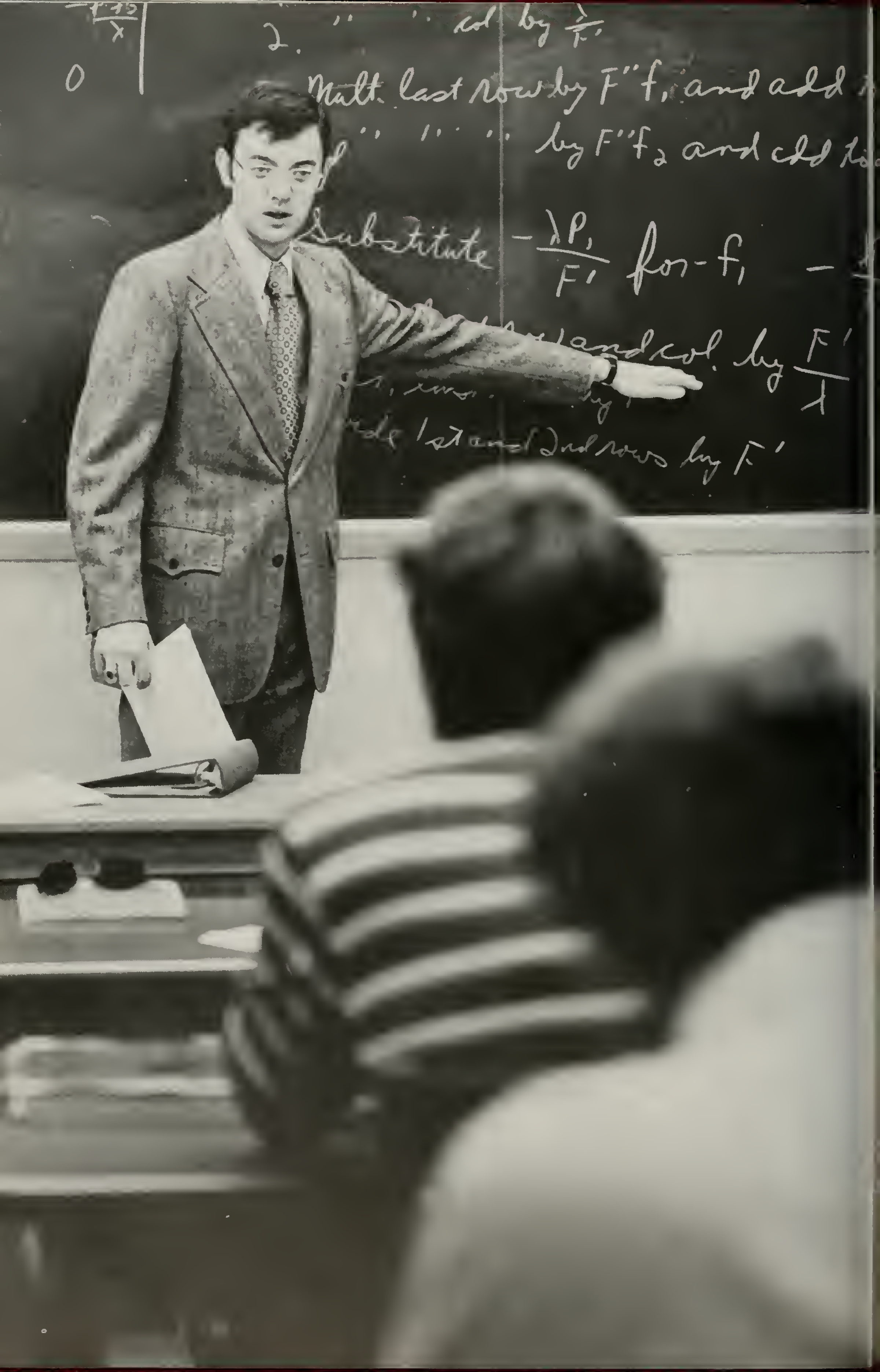

Mult. last row by F''f, and add
by F''f₂ and add to
Substitute −λP₁/F' for −f₁ −
and col. by F'/λ
1st and 2nd rows by F'

1

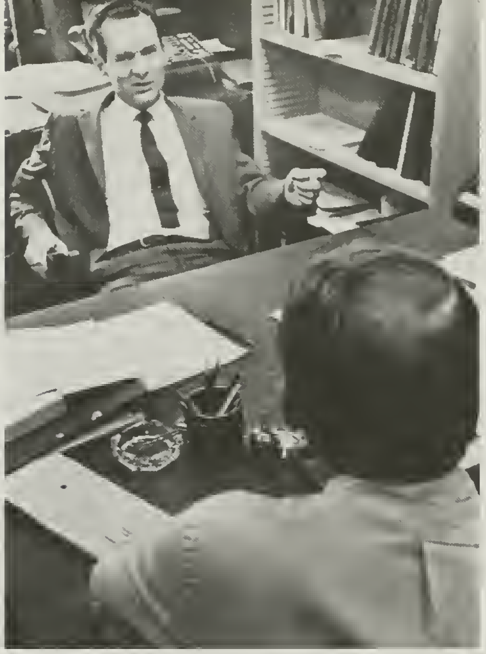
Degree Programs

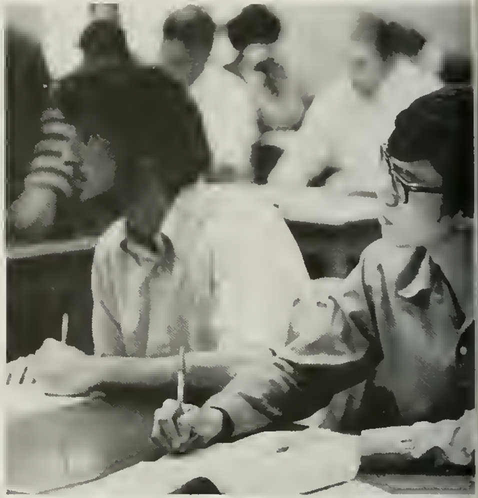
The Master of Business Administration

Most students who complete the M.B.A. program will begin a professional career that will span several decades. During that period they will hold positions of different types and of increasing responsibility. A deliberate decision to invest two years in the M.B.A. should be based on a careful estimate of how well the program prepares the student to perform during his early career and how well it prepares him to learn from his experiences and from other people in order to succeed in his later career.

During the coming several decades two major types of changes will occur. First, the structure of business and industry will change, creating new classes of problems unlike those of the past. For this reason, preparation to solve problems only within the structure of today's world would fail as preparation for solving problems arising from a new structure, and would fail as preparation to make significant departures from old structures. Second, the science of management and administration will change, making available new technology for use in solving the most pressing problems. The science of management is young and the rate of change will be very high. Therefore, a large proportion of the useful managerial technology available in a decade or more is yet to be developed.

To prepare for those changes, an M.B.A. program needs to graduate managers who are able to understand and to anticipate changes in problems that arise from shifts to new structures of organization in business and industry. Those graduates ought to be prepared to foster changes that improve the structure and operations of economic organizations in our society. Associated with these requirements is the need for an M.B.A. program to provide the intellectual foundations necessary to remain abreast of the rapidly changing sciences that underlie the most creative and useful management development.





The Duke M.B.A. curriculum is designed to meet these challenges through an emphasis on concepts and theory, and on their application. This involves evaluating and improving theory for use in the analysis of complex problems and the creation of effective plans. The curriculum is intended as managerial preparation in which an essential ingredient is the integration of the plans and activities of the various parts of a large organization, or of the various organizations that ought to build cooperative relationships. The program prepares the M.B.A. for imaginative, effective coordination of unlike organizations and for responsibilities in a wide variety of assignments within these complex structures. A dominant theme is that good theory is useful theory, and direct application is one of the major uses of the concepts and theory in the curriculum. Finally, this emphasis develops the basc needed to keep abreast of the rapidly developing science and technology of management.

Although the emphasis on concepts and theory continues throughout the program, and should continue into the period of professional practice, the proportionate stress on the application of these foundations is steadily increased. The

Duke M.B.A. places heavy accent on converting concepts and theories of the sciences into managerially useful administrative technology.

The particular focus on concepts and theory is planned to produce a special flexibility in the career of the Duke M.B.A. By examining problems to discover their underlying structure and by designing solutions to fit that structure, the student develops the flexibility to do two very important things. The first is to identify the common form of problems that in many respects appear to be different. This permits learning to be very efficient by giving each lesson learned the flexibility required for application to many apparently different problems. The second is to grasp very quickly the essential nature of tasks or positions with which experience is quite limited. This permits effective performance in the variety of positions needed to develop to maximum professional potential.

To achieve this flexibility, the Duke M.B.A. student devotes the first three semesters to development of the managerial theory and tools of analysis needed as a foundation for the specialties we offer and for later professional advancement. Through this approach each student is prepared for advanced work in any of the elective fields and is able to avoid a rigid commitment to any one field of study or practice. Hence, through thorough preparation in the concepts and theory that underlie the full range of managerial fields, the student becomes, as much as possible, flexible and independent of a single line of opportunity.

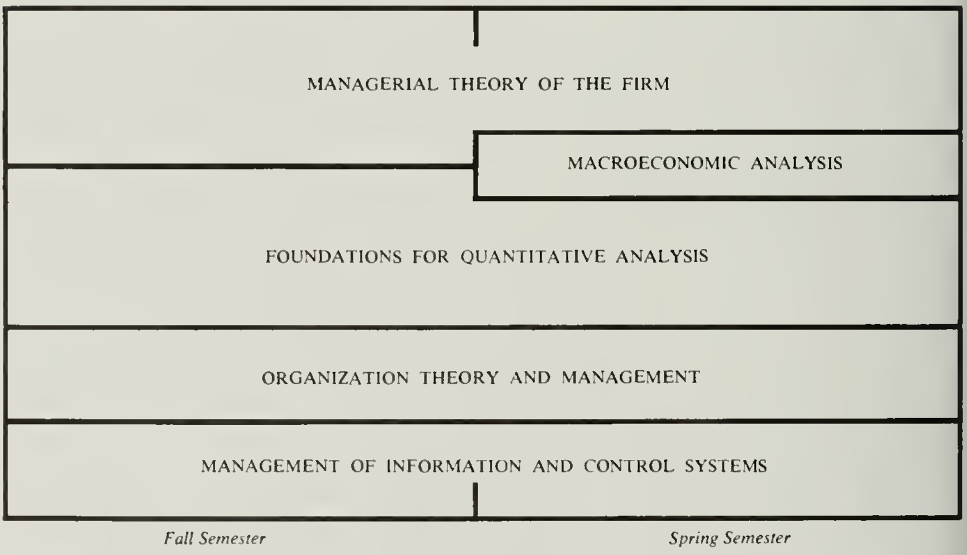
MASTER OF BUSINESS ADMINISTRATION CURRICULUM

The M.B.A. requires four semesters of full-time work, totaling 64 semester hours of graduate course credit. Because the Duke M.B.A. program is so different from most undergraduate work in business administration, only on rare occasions will a student be able to substitute more advanced work for one or more core courses, and this is more likely in mathematics than in other subjects. In the summer between the first and second years, the M.B.A. student is expected to gain practical experience through related employment, and approximately seventeen weeks between the spring and following fall semesters are scheduled for this experience. This period, aside from its obvious financial benefits, aids the student in his selection of an area of study for his practicum, which is part of the fourth

semester's work. In many cases, the student will select a topic for his practicum during the summer.

First Year Program. Course work for the first year of the M.B.A. program provides the basic knowledge required to understand and to analyze the operations of a firm in a market economy. The topics are arranged to reinforce the knowledge gained in one course by subsequent use in other courses. This sequencing also permits basic assumptions, developed in a tight, theoretical structure in one area, to be related and examined in subsequent work in other areas.

The courses are organized to consider problems from the functional areas of marketing, production, finance and personnel, and to develop the supporting and controlling tools of analysis. These include mathematics and statistics, accounting, management information systems, and control mechanisms. The individual courses consider problems that are similar in their form so that major tools of analysis and approaches to problems can be learned in their generic patterns for application to each of the appropriate specific problems. Students should view the curriculum as a set of experiences whose design is an illustration of some of the major lessons it teaches.


MANAGERIAL THEORY OF THE FIRM
MACROECONOMIC ANALYSIS
FOUNDATIONS FOR QUANTITATIVE ANALYSIS
ORGANIZATION THEORY AND MANAGEMENT
MANAGEMENT OF INFORMATION AND CONTROL SYSTEMS
Fall Semester
Spring Semester

First Year Courses

300. Managerial Theory of the Firm I. Develops the fundamental theory of the firm on which analysis and planning of operation of the economic enterprise is based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, and production are examined through classical economic theory and its modern extensions. Emphasis is on optimal decisions and formulation of economic strategy within the market economy. 5 units.*

301. Managerial Theory of the Firm II. Optimal planning of the firm's operations through development of models of the firm in which decision variables are production levels, inventory levels, operating budgets and capital budgets, for both certainty and uncertainty situations. The development and theoretical analysis of the models involve linear economic models, linear programming models, integer programming models, and the von Neumann Morgenstern expected utility hypothesis for decision-making under uncertainty. 4 units.

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*One unit is equivalent to one semester hour.

310. Foundations for Quantitative Analysis I. Considers mathematical structures which are useful models for subsystems of an economic enterprise. The structures considered provide the framework for understanding and analyzing complex organizations and economic events, and develop problem-solving tools and techniques. This course and B.A. 311 provide the mathematical and statistical background beyond beginning calculus required in the M.B.A. program. The major topics are: sets, relations, and functions; introductory probability theory; linear algebra; classical optimization techniques; and introduction to linear programming. 5 units.

311. Foundations for Quantitative Analysis II. Continuation of B.A. 310. The major topics are: probability, statistical decision theory, sampling theory, estimation and hypothesis testing, and regression and correlation analysis. 4 units.

320. Management of Information and Control Systems I. The financial accounting model is developed as a critical subset of the general information system of the firm. This initial model is extended through consideration of general systems theory to encompass the economic and organizational models of the firm developed in B.A. 300 and B.A. 330. 3 units.

321. Management of Information and Control Systems II. The classical cost accounting model is developed and then restructured to provide data for planning and control of complex enterprises through use of modern managerial technology. This includes design of an information system that provides the data needed for advanced economic and organizational models of the firm. 3 units.

330. Organization Theory and Management I. Design, coordination, and control of the modern business corporation. The essentials of cybernetics, information economics, and team theory are developed. This theoretical foundation together with neoclassical theory of the firm are applied to the solution of the following classes of problems: design of transfer pricing and other incentive systems for coordination; design of systems for collecting and disseminating information for decision-making throughout the firm; design of budgeting procedures and other systems for internal resource allocation; and critical evaluation of special solutions to the short-run control problem, such as "management-by-exception." Written cases and computer-based business games, where appropriate, are used to illustrate applications of theory to practical situations. 3 units.

331. Organization Theory and Management II. The theory of adaptive control systems in organizations, begun in B.A. 330, is developed further. A theory of goal formation and structural change is developed and applied to an analysis of the long-run development of major corporations in such a way that the historical lessons are transferable to current and future problems in organization change. Recent psychological and sociological theories of individual and small group behavior are critically reviewed in light of the cybernetic framework developed earlier. Given these new macro and micro level perspectives, the organization design problem, treated in B.A. 330, is reconceptualized, and computer simulation models of organization behavior that incorporate these new perspectives are examined. The student is encouraged to use the computer to explore his own variations of these basic models. 3 units.

341. Macroeconomic Analysis. Focuses on understanding the determinants of price level, rate of growth, and level of aggregate income, employment, and output in the economy. The purpose is to develop an understanding of the rationale of government policies and the impact of governmental behavior on the national aggregates and, in turn, the effect of these factors on the level of activity in the various industrial sectors. 2 units.

Second Year Program. The primary thrust of the third semester's work is toward more advanced analysis of how the firm should relate its internal and external plans and actions. The external relationships can be classified into those which are competitive, those which are cooperative, and those which have characteristics of both. The internal relationships include the planning and control of manufacturing and financial operations. The advanced tools of analysis, conceptual structure, and legal constraints needed to work with these complex relationships are developed.

The final semester of the M.B.A. program builds upon the foundations laid during the first three semesters. This work is directed toward understanding and solving actual problems of the firm, using the tools of analysis and the conceptual framework developed earlier. The schedule provides for a two-week period when there are no classes, in order to give time for concentrated work on the practicum and to interview with potential employers.

<table>
<tr><td colspan="2">OPERATIONS RESEARCH</td><td>PUBLIC POLICY OF THE FIRM</td></tr>
<tr><td>COOPERATIVE DECISIONS
AND
COMPETITIVE STRATEGIES</td><td rowspan="2">COOPERATIVE - COMPETITIVE
RELATIONS AND DECISIONS</td><td>ELECTIVE</td></tr>
<tr><td>ORGANIZATION DESIGN
AND
INTERNAL OPERATIONS</td><td>ELECTIVE</td></tr>
<tr><td colspan="2">LAW AS A CONSTRAINT FOR BUSINESS</td><td>PRACTICUM</td></tr>
<tr><td colspan="2"><i>Fall Semester</i></td><td><i>Spring Semester</i></td></tr>
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Second Year Courses

312. Operations Research. Deals with development of mathematical models of various aspects of economic operations, including topics in the areas of queuing, inventory, and maintenance. General procedures for the solution of mathematical problems involving the identification of maxima and minima are studied along with simulation and the use of the computer for the generation of solutions. 4 units.

302. Cooperative Decisions and Competitive Strategies. Deals with the problems of choosing cooperative economic relations in order to effect exchange transactions, and the problems of determining competitive behavior. The efficiency and stability of various forms of cooperative vertical market structure under simple competitive conditions are rigorously studied. Competitive market decisions are studied in the context of the formulation and solution of purely competitive market games. Although the more advanced and rigorous portions of the course are mathematical and theoretical, increasing emphasis is focused on the practical applications to markets and the development of realistic combination of cooperative and competitive programs. 4 units.

332. Organization Design and Internal Operations. Design of organizations for coordination and control of the internal operation. The topics include: (*a*) specialization, both functional and hierarchical, with particular attention to the problems of decomposition and decentralization; (*b*) coordination, including cost-benefit analysis of alternative means of coordination; and (*c*) control, with emphasis on the role of information systems and the design of decision rules. These topics are examined for the organization in general, but with specific reference and application to the production and finance segments. 4 units.

303. Cooperative-Competitive Relations and Decisions. A simultaneous treatment of the firm's decisions on its cooperative and competitive behavior, and on the design of its internal structure and its production and financial operations. The subject of the course is the firm's coordinated treatment of the decision variables which reflect its direct relations to the economic units with which it cooperates and competes to effect exchange transactions, and those which relate to the form of its internal operations and organizational structures. 2 units.

349. Law as a Constraint for Business. Considers the major legislation, court cases, and regulations of federal agencies which constrain the area within which the firm must operate, including aspects of the commercial code, anti-trust law, and labor and fair employment law. 2 units.

350. Public Policy of the Firm. Focuses on analysis of the relationships between the firm and the three segments of society: the public at large, the organizations and individuals in close contact with the firm, and the members, or employees, of the firm. Primary emphasis of the other parts of the M.B.A. program is on design and decision, oriented to reach the goals of the firm. This course treats some of the problems involved in selecting the ends and restraints from among feasible alternatives; i.e., the problems of developing a policy of the firm toward the society of which it is a part. 3 units.

390. The Practicum. The Practicum is individually designed and is a major component of the second-year program designed to give the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of the real situation and the explicit formulation of the problem. That is, the problem which the student treats in the Practicum should not be described with only the solution left to be developed. The important task of identifying and specifying the actual problem, perhaps after being directed to correct some undesirable symptoms, is an integral part of the Practicum.

The Practicum report should propose a solution to the problem specified and should contain the explanation and logic that supports those recommendations. This solution should be one that can be implemented and must not ask for human

or nonhuman resources unavailable for use in the proposed solution. Further, where the solution of the problem is sensitive to the assumptions made, those assumptions must be realistic. The Practicum is supervised by one of the two professors teaching the electives selected by the student. 5 units.

313. Advanced Operations Research. Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the medical center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or development of new ones. 4 units.

323. Controllership. Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 4 units.

324. External Reporting and Auditing. Builds on the information systems sequence of the first year and the public policy course, in terms of developing requirements of the system for reporting to parties external to the firm who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 4 units.

333. Manpower Planning and Management. An application of behavioral and economic theories and of quantitative techniques to management of the firm's human resources, including treatment of both labor and management personnel. Detailed examination of American occupational structure (e.g., mobility patterns, increasing specialization, and professionalization) and analysis of the labor union as an institution are included. Topics studied within the constraints of industrial, educational, and labor institutional structure are: employee testing, selection and assignment, training and development, performance evaluation and optimal incentive systems, strategic and tactical factors in collective bargaining. 4 units.

351. Finance. Focuses on management of the financial affairs of the firm, in its attempt to develop an optimal capital structure, and includes: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 4 units.

353. Marketing. Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involves a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 4 units.

355. Production. Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management.. Two major problem areas are covered, the design (or planning) of manufacturing systems and their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods and processes, facilities planning. Sub-topics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 4 units.

The M.B.A.-J.D. Program

The Schools of Law and Business Administration offer a combined M.B.A. and J.D. program that can be completed in four academic years of work. The first two years are allocated to a full year in each program in either sequence. The latter two years are devoted to an integrated program that meets the requirements for completion of both the M.B.A. and J.D. Both degrees are awarded upon successful completion of the combined program.

To apply for admission to this program, application for both the M.B.A. and the J.D. programs is required. Additional information about the program and application procedures may be obtained on request from the Director of Admissions of the Graduate School of Business Administration.

The Master of Science in Management

For some students, combining graduate study with work experience provides more effective professional development than full-time study. The Duke Master of Science in Management Evening Program serves this need by offering a sound education in management, and, at the same time, allowing the student to continue in a managerial or administrative position.

The overall purpose of the Master of Science in Management Program is to contribute to the growth and development of promising managers as they attempt to improve the performance of the organizations in which they work. Emphasized in the program are the common form of problems within the several segments of the organization and the interrelationships among solutions to problems. This area of study enhances the manager's capacity to identify the essential variables in a problem and to distinguish between the common form among problems and the uniqueness in any specific case. In addition, students are taught modern tools of analysis to be used in understanding and solving problems.

This background in management—emphasizing foundations, concepts, and the modern tools of analysis—improves the manager's ability to learn from events in his environment and to do so in an integrated, orderly manner.

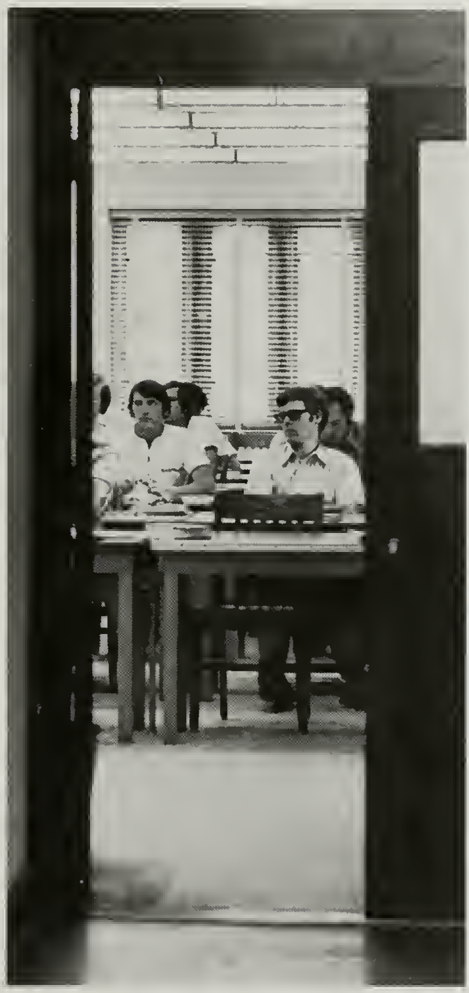
Completion of the program requires approximately twenty months of study, with classes being held on Monday and Thursday each week from 5:00 to 9:00 p.m. Additional information about the curriculum is available on request.

Application credentials are identical to those for the M.B.A. program. The only specific course prerequisite is one year of the calculus, but applicants are expected to hold full-time positions and to continue in them while enrolled in the program.

The Doctor of Philosophy

The objective of the Ph.D. program is to prepare candidates for academic or business careers, and places primary stress on development of the capability to engage effectively in research related to the management of complex organizations.

Courses. One year of study (30 semester hours) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, and a set of three individually designed courses in an elected field of administration. These courses, which are offered on a tutorial basis,



may cut across traditional disciplinary boundaries in a manner that integrates these disciplines.

Research Tools. Satisfactory preparation in a research-tool area is required. Reading knowledge in one foreign language is accepted as meeting this requirement. An alternative is advanced study in some other discipline approved by the facility of the Graduate School of Business Administration, the Executive Committee of the Graduate Faculty, and the Dean of the Graduate School.

Preliminary Examinations. Economic theory, quantitative methods, and the elected field of administration are the areas covered by the preliminary examinations. Normally, students are expected to take these examinations following the completion of required course work and the research-tool preparation.

Doctoral Dissertation. The doctoral dissertation is expected to be original research in some area of theory, analytic methods, or administrative application related to improvement of the performance of economic organizations. The main purpose of the dissertation should be to contribute to scientific knowledge pertinent to management of organizations.

2

Admission and Financial Information

Admission

Applicants for admission to the Duke M.B.A. program should have earned a baccalaureate degree with a sufficiently good record of performance to demonstrate the ability to engage in rigorous analysis. Neither prior business experience nor undergraduate study in business administration is necessary, but prior experience in business, government, or other organizations is viewed favorably. The M.B.A. program is designed to accept undergraduate majors from a broad range of disciplines, including the physical, biological, and social sciences, engineering, mathematics, and philosophy.

The only specific course prerequisite for admission is one year of calculus at the college level. If an applicant is deficient in this requirement, he may take the requisite mathematics courses in Duke University's Department of Mathematics during the summer, but courses at any college or university are acceptable for meeting the requirement.

Both admission and financial aid decisions are made to encourage students from all races, religions, national origins, and both sexes to matriculate in the Graduate School of Business Administration. Admission and financial aid are based on merit, and special recognition is given to the difficulty in using traditional credentials in estimating merit of applicants from some minority group experiences.

Application Information. Applicants may submit any information about their academic or work performance in support of their application. Information of greatest value is that which supplements the required documents and completed forms in the process of estimating how well the applicant will do in the program and how well the program will prepare the applicant to achieve his own professional goals.

The minimum application credentials are:

1. A completed application form.
2. Two copies of all current transcripts from schools attended.
3. Before matriculation, two copies of final transcripts from each school attended.
4. Personal and professional recommendations.
5. Score on the Admission Test for Graduate Study in Business.

Application Deadlines. An early admissions policy is followed in the Graduate School of Business Administration, and admission decisions are made as applications are completed. Normally, students should complete the application by March 1. Ten percent of the positions in entering class are reserved for late admission in the latter part of the spring and summer.

Admission of Foreign Students. Fully qualified students from outside the United States are welcome at the Graduate School of Business Administration. They are encouraged to pursue normal degree requirements but may also be admitted for non-degree course work if the length of their stay in the United States does not permit time for the completion of a degree. In applying for admission, the foreign student should submit, in addition to the credentials required of all students, the following:

1. If his native language is not English, certification of ability to use English through scores on tests provided by the Educational Testing Service (TOEFL).
2. A statement certified by a responsible person that his finances are sufficient to maintain him during his stay at Duke University. (Please see the section below on financial requirements.)
3. A statement by a qualified physician describing the physical and mental health of the applicant.

Notification of Status. When the applicant has been accepted, he will be sent a letter of admission and an acceptance form. The process of admission is not complete until the statement of acceptance has been returned to the Director of Admissions, Graduate School of Business Administration.

Successful applicants will be offered either full admission or provisional admission. Provisional admission is offered to students who warrant admission but who need additional time to complete admission requirements. In each case, the requirements must be met before matriculation.

Admission Test for Graduate Study in Business. The Admission Test for Graduate Study in Business, required of all applicants, is administered by the Educational Testing Service for a fee of $10. Detailed information about the test and application forms may be obtained by writing directly to the Educational Testing Service, Box 966, Princeton, New Jersey 08540.

The examination is administered at many centers throughout the United States and abroad. Arrangements to take the test at an established center must be made two weeks before the test date (six weeks at established foreign centers). The examination is given in November, February, April, and July. Special centers may be arranged for persons distant from established centers. Requests for such accommodations must be made at least three weeks prior to the selected test date. Fellowship applicants should take the test in November or February. Other applicants may take it as late as April, but the earlier dates are strongly recommended.

Financial Information

The forms of financial aid range from fellowships that provide both tuition and stipend to a special loan program. The loan program allows tuition payment to be deferred until the period of professional practice. Several combinations of these two forms of financial aid are available and are awarded primarily on the basis of merit with financial need as an important factor in determining the amount of award or loan. The problems involved in evaluating the traditional credentials of some minority group applicants are given special attention.

The deferred tuition loan permits the student to make tuition payment over periods ranging from two to thirty years. Payment is based on a percentage of gross taxable income, with special arrangements for early payment. Detailed information and payment schedules are available upon request.

A small number of assistantships are available for students during their second year of graduate study. These are granted on the basis of the specific skills needed for the research projects in the School.

Financial Aid Application. Financial aid decisions are made as applications are completed, with the first awards being granted on March 1. To be considered for the full range of awards, applicants should complete both admissions and financial aid procedures early. On the other hand, several awards are reserved for late decision on those applications which reasonably could not have been submitted early.

The Duke Graduate School of Business Administration is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form entitled "Application for Financial Aid for the Academic Year 1973-74." The GAPSFAS application may be obtained from the financial aid officer at the institution in which the applicant is currently enrolled. It will be available on campuses after September 15, 1972. The GAPSFAS application may also be obtained from the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540, and should be filed no later than February 1 in order to assure its receipt at Duke by March 1. It contains sections to be completed by the applicant, by the spouse or spouse-to-be, and by the applicant's parents. The student must complete the applicant and spouse sections to be considered for aid at Duke University.

Tuition and Other Costs. The following table shows tuition and fees for students in the Graduate School of Business Administration for the year 1972-73. All charges for each semester are payable at the time of registration for that semester, and are subject to change without notice.

Tuition (full semester program of 16 units)	$1150.00
Optional Annual Athletic Fee (not including federal tax)	25.00
Late Registration Fee	10.00
Doctoral Candidates Fees	
Dissertation Binding Fee (3 copies)	15.00
Dissertation Microfilming Fee	25.00
In Absentia Fee (1 unit per semester)	72.00

After the day of registration, no refund of tuition will be made except for involuntary withdrawal to enter the armed forces or in accordance with established University policy.

Annual expenses vary according to individual tastes, especially for family support, food, recreation, travel, and clothing. Estimates of normal, basic annual expenses should include $2,300 for tuition, approximately $150 for books, and a minimum of $340 for living accommodations.

3

General Information

The University

The James B. Duke Indenture of Trust of 1924 provided the means to transform a small, church-supported undergraduate college into a university of recognized quality among major American Universities. The Indenture identified the need to include a School of Business among the professional schools of the University. In 1969, the Graduate School of Business Administration was added to the professional schools of Law, Medicine, Engineering, Divinity, Nursing, and Forestry.

Students at Duke number 8,450 of whom 2,750 are enrolled in graduate-professional programs. The balanced size and close, informal association among professional schools and related areas of study provides an exceptional opportunity for graduate students to benefit from strengths throughout the University.

The Campus. The Duke campus is located in Durham, North Carolina, a metropolitan area of approximately 100,000 people near the center of the State. Duke is an integral part of the growing Research Triangle of the Piedmont section of North Carolina. The Triangle, an education-research complex, encompasses the resources of the several universities in Durham, Raleigh, and Chapel Hill. These cities provide opportunities and facilities for off-campus cultural, recreational, and social activities. The campus is also within a few hours of the mountains and beaches, providing outstanding skiing, swimming, boating, and other outdoor recreational activities.

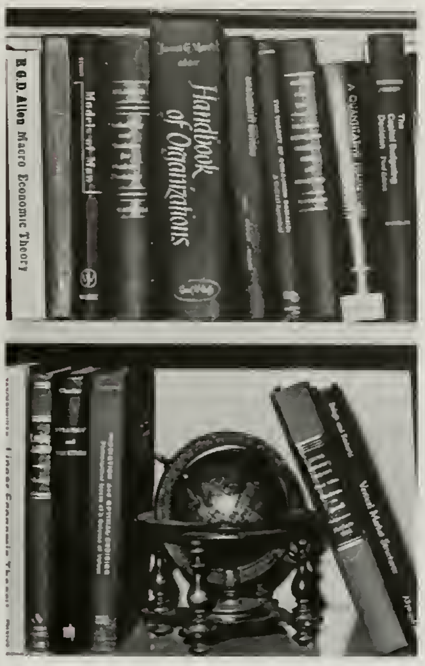
The Library. The William R. Perkins Library is located opposite the Graduate School of Business Administration. The G.S.B.A. Reading Room and most of the collections from the basic disciplines related to management are in the Perkins Library. In addition to the two-million volume collection available there, students have access to Duke's Law and Engineering Libraries.

Computing Facilities. The Duke University Computation Center is intended to provide the University faculty and students with a facility for research and instruction in computing. The Center is presently equipped with an IBM 360 Model 40 which is connected by high-speed lines to an IBM 370 Model 165 located at the Triangle Universities Computation Center in the Research Triangle Park. Of special interest to G.S.B.A. students, a medium speed terminal with associated slow speed terminals for interactive computing is adjacent to the Business School. These are the terminals most used by M.B.A. candidates for access to the Model 165.

Office of Placement Services. Duke University provides placement services for students and alumni. On-campus interviews for permanent or summer employment are arranged with a broad spectrum of American industry for those persons who register with the Office of Placement Services. It is expected that all students enrolled in the second year of the M.B.A. program will make their off-campus interview trips during the spring holiday which normally occur during the last week of February or the first week in March.

Living Accommodations. Duke University maintains living accommodations for single graduate students.

Rooms in residence halls, spaces in Town House Apartments, or other rental units may be reserved by single applicants after acceptance by the Graduate School and after a $50 deposit has been paid to Duke University. Assignment priority is


R G D Allen Macro Economic Theory
Handbook of Organizations

established by the date of receipt of completed housing applications with deposits in the Office of the Director of Housing Management. Regulations governing room and security deposits and occupancy of rooms and apartments will be provided by the Office of Housing Management at the time housing application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

Double-occupancy rental charge in the Graduate Center and in the Hanes Annex is $340 per academic year. Town House Apartments, between the East and West Campuses, include thirty two-bedroom units, each furnished for three graduate women students. Two students occupy the master bedroom; the third occupies a smaller bedroom. A living room, kitchen, and one-and-a-half baths complete these comfortable, tastefully appointed living units. The rental rate is $626 per person for the academic year.

The Department of Housing Management is prepared to assist married graduate and professional students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and complex units are available in limited numbers from time to time.

Accepted applicants to the G.S.B.A. will receive a packet of housing information upon return of acceptance of admission to the Graduate School. The form used for this purpose is sent to applicants with notification of acceptance to the program.

Food Services. Food services is available on both the East and West Campuses. The dining facilities on the West Campus include cafeterias and a table service dining room where full meals and *a la carte* items are served. The Graduate Center has a cafeteria open at meal hours and a coffee lounge which is open until 11:00 p.m.

Because of the large numbers served in the dining halls, it is not possible to arrange special diets for individual students. The cost of meals approximates $2.50 to $3.00 per day, depending upon individual tastes.

Standards of Conduct. Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct. The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, from time to time, are put into effect by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University.

Motor Vehicles. Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of $10 for each automobile and $5 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least $10,000 per person and a $20,000 per accident for personal injuries, and $5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. To secure the benefits of these services a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged for, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements with the Mid-South Insurance Company for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve month period. The 1972-73 rate is $29.90 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete. The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full 12-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from August 31. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the Dean of the Graduate School of Business Administration.

Faculty of the Graduate School of Business Administration

The faculty has grown from a planning group of four members in 1967 to a group of eight members in 1970 when the first class of students entered the M.B.A. program, and then to a group of fifteen members in 1972. Several members will be added each year until the faculty includes twenty-five to thirty members.

The student-to-faculty ratio in the School is maintained at a level permitting development of close professional relationships and encouraging individual assistance in academic and professional development. The student-to-teaching faculty ratio in the M.B.A. program has been about 7 to 1 and will continue at that level. In addition, faculty engaged in major research projects and other teaching assignments are available to participate with M.B.A. students. This balance is very attractive for both students and faculty in their joint work toward maximum professional development of the M.B.A. candidate.

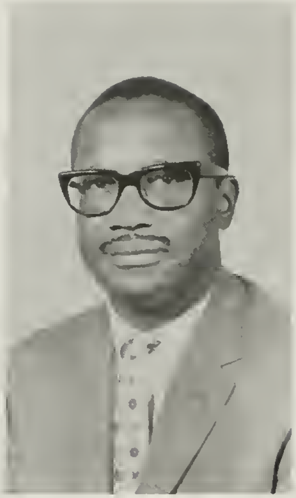
The faculty, the universities in which they received their formal education, their academic rank, the main areas of interest follow:

Carole A. Aldrich, B.S., M.S.I.A, Ph.D., *Assistant Professor of Business Administration*

B.S. (Industrial Management), M.S.I.A., Ph.D. Carnegie-Mellon University. Economic models of the firm with special interests in the theory, measurement, and management of technical change.

Helmy H. Baligh, B.A., M.B.A., Ph.D., *Professor of Business Administration*

B.A. (Philosophy, Politics and Economics) Oxford University; M.B.A., Ph.D. University of California at Berkeley. Market theory and the design and control of general competitive and cooperative strategies. Analysis and design of vertical market structures (channels of distribution) for both business and social purposes.



Joseph Battle, B.S., M.S., Ph.D., *Associate Professor of Business Administration*

B.S. (Mathematics and Physics) North Carolina Central University; M.S., Ph.D. (Mathematics) University of Michigan. Development and application of mathematics in operations analysis and in information systems.

Richard M. Burton, B. S., M.B.A., D.B.A., *Associate Professor of Business Administration*

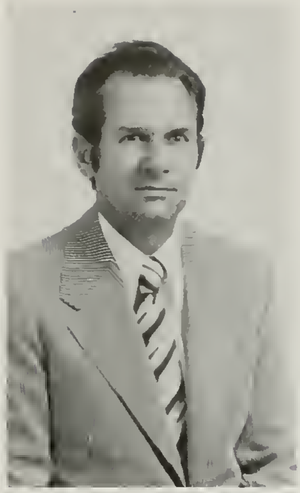
B.S. (Engineering Mechanics), M.B.A., D.B.A. University of Illinois. Systems analysis, operations research, and organization theory with applications to production planning, scheduling, capital budgeting, and design of organizations as a problem in system design.

William W. Damon, B.S., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Mathematics and Physics) Purdue University; M.B.A., Ph.D. (Quantitative Analysis, Finance) Cornell University. Operations research and integrated planning of production and inventory, work force, marketing, and cash flow; corporate financial structure and investment theory.

David C. Dellinger, B.S., M.S., Ph.D., *Associate Professor of Business Administration*

B.S. (Mechanical Engineering) Duke University; M.S., Ph.D. (Industrial Engineering-Operations Research) Stanford University. The conduct of operations research studies to solve problems and the implementation of the solutions, including the optimal handling of human resources in the implementation process.



Robert L. Hagerman, B.S., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Accounting), M.B.A., Ph.D. (Business Administration) University of Rochester. Financial accounting, financial reporting, banking and government regulation, especially in financial markets.

Thomas F. Keller, A.B., M.B.A., Ph.D., C.P.A., *Professor of Business Administration*

A.B. (Economics and Accounting) Duke University; M.B.A., Ph.D. (Accounting) University of Michigan. Design of accounting information and control systems for use in meeting requirements of external reporting and modern management.

Arthur J. Kuhn, B.S., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Mechanical Engineering), M.B.A. University of Illinois; Ph.D. (Business Administration) University of California at Berkeley. Organization theory, sociology, systems theory, and economic and sociological control systems.

Danny J. Laughhunn, B.S., M.B.A., D.B.A., *Associate Professor of Business Administration*

B.S. (Mechanical Engineering), M.B.A. and D.B.A. University of Illinois at Urbana. Production, finance, and operations research with emphasis on dynamic programming, capital budgeting, and long-range planning. Statistics and control theory.

Steven F. Maier, B.S., M.S., Ph.D., *Assistant Professor of Business Administration*

B.S. (Industrial Engineering) Cornell University; M.S., Ph.D. (Operations Research) Stanford University. Theory and application of structured linear programs; network flow and graph theory; nonlinear programming; numerical analysis of linear systems.

Russell J. Petersen, B.S., M.S., Ph.D., C.P.A., *Assistant Professor of Business Administration*

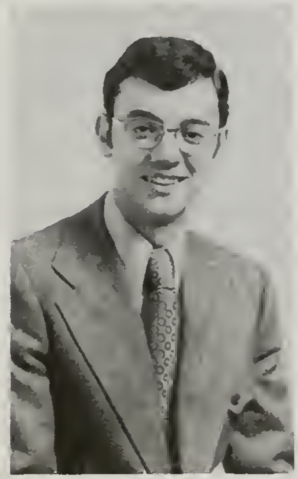
B.S. (Accounting) Oregon State University; M.S. (Accounting and Statistics) University of Oregon; Ph.D. (Accounting) University of Washington. Accounting and information systems with special focus on simulation and the study of measurement models and their impact on investment decisions.

Louis R. Pondy, B.S., Ph.D., *Associate Professor of Business Administration*

B.S. (Physics), Ph.D. (Industrial Administration) Carnegie-Mellon University. Organization theory, with special emphasis on the use of cybernetics and economic theory in optimal organization design and human resource management.

James Vander Weide, B.S., Ph.D.,* *Assistant Professor of Business Administration*

B.S. (Economics) Cornell University; Ph.D. (Finance) Northwestern University. Finance, including portfolio theory, capital budgeting, financial markets and development of an optimal corporate financial structure and operating policy. Econometrics and mathematical analysis.



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*Degree not complete as of the date of publication of this *Bulletin.*

Louis D. Volpp, B.S., M.A., Ph.D., *Professor of Business Administration*

B.S. (General Science) Iowa State University; M.A. (Marketing), Ph.D. (Business Administration) State University of Iowa. Marketing and managerial economics, with special emphasis on analysis, planning, and control of complex enterprises. Market measurement and forecasting.

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A. Kenneth Pye, LL.M., *University Counsel*

Graduate School of Business Administration

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Helmy H. Baligh, Ph.D., *Associate Dean*
Thomas F. Keller, Ph.D., *Chairman of the Doctor of Philosophy*
Richard M. Burton, Ph.D.. *Director of Admissions*

Photo credits:

Jimmy Wallace: 2 top left, 12, 16, 19 right, 29

All others except portraits by Carolyn H. Vaughan.

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Calendar of the Graduate School of Business Administration

1973-74

August	
31	Registration
September	
4	Classes begin
November	
21	Thanksgiving recess begins
26	Classes resume
December	
11	Last day of classes
12-14	Final examinations
January	
14	Classes begin
March	
18	Spring vacation begins
25	Classes resume—First year students, second year Practicum research
April	
1	Classes resume—Second year students
26	Last day of classes
4/29-5/2	Final examinations
May	
12	Commencement

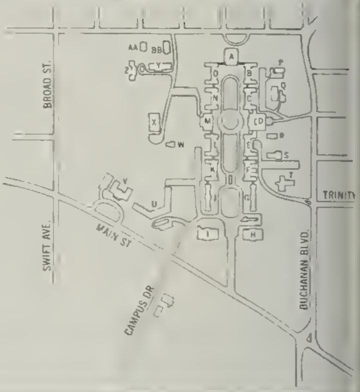
1974-75

August	
30	Registration
September	
3	Classes begin
November	
27	Thanksgiving recess begins
December	
2	Classes resume
10	Last day of classes
11-13	Final examinations
January	
13	Classes begin
March	
17	Spring vacation begins
24	Classes resume—First year students, second year Practicum research
31	Classes resume—Second year students
April	
25	Last day of classes
28-30	Final examinations
May	
11	Commencement

MAP OF DUKE UNIVERSITY

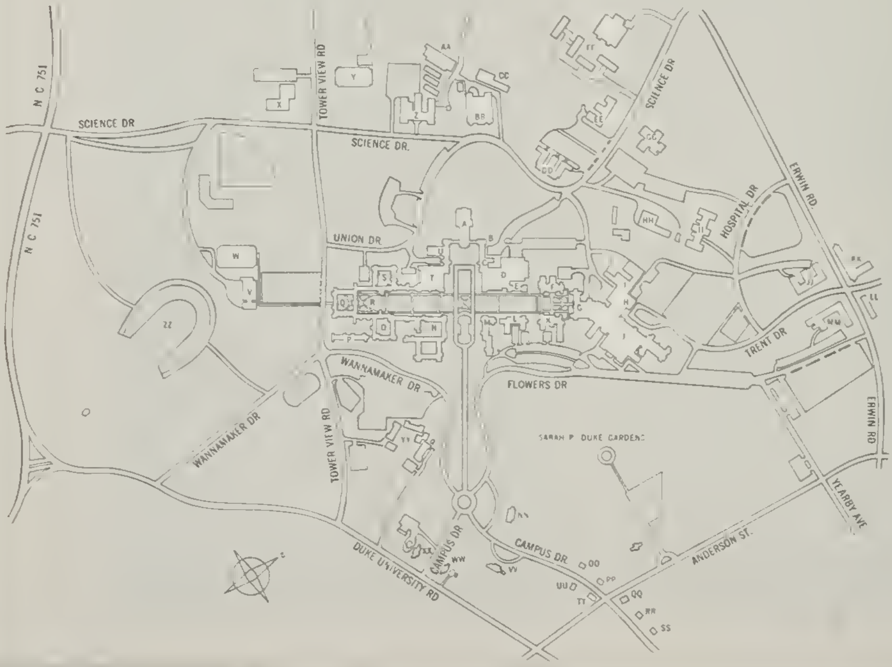
East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laborat
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Researc Buildings
GG	Nanaline H. Duke Medic Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program A Better Chance Progra
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



BULLETIN OF DUKE UNIVERSITY

The Graduate School of
Business Administration

Vol. 45 No. 2A October 1972

Bulletin of Duke University 1973

Summer Session

Bulletin of Duke University

Summer Session

1973

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Calendar of the Summer Session

1973

First Term: May 14-June 15
Second Term: June 18-July 20
Third Term: July 23-August 24

May	
11	Friday—Completion of registration for Term I
13	Sunday—Noon, dormitories ready for occupancy
14	Monday—First class day except for undergraduate courses in chemistry, geology, and physics
19	Saturday—Classes will be held
21	Monday—First class day for chemistry, geology, and physics
26	Saturday—Classes will be held
June	
10-16	Sunday-Saturday—Basketball Clinic
11	Monday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open only to students eligible to use English as a foreign language.
14-15	Thursday and Friday—Final examinations for first term
15	Friday—Examination for students electing English for a foreign language requirement; room and hours to be announced.
15	Friday—Completion of registration for Term II
17-23	Sunday-Saturday—Basketball Clinic
17	Sunday—Noon, dormitories ready for occupancy
18	Monday—First class day for all courses in Term II
23	Saturday—Classes will be held
24-30	Sunday-Saturday—Basketball Clinic
30	Saturday—Classes will be held
July	
2-28	Monday-Saturday—Medical Mycology Course
13	Friday—Examinations for undergraduate courses in chemistry, geology, and physics, Term II
19-20	Thursday and Friday—Final examinations for second term
20	Friday—Completion of registration for Term III
22	Sunday—Noon, dormitories ready for occupancy
23	Monday—First class day for Term III
28	Saturday—Classes will be held
August	
1	Wednesday—Final date for filing with Graduate School Office the statement of intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the statement of intention.
11	Saturday—Classes will be held
15	Wednesday—Last day for submitting theses for advanced degrees
23-24	Thursday and Friday—Final examinations for third term
24	Friday—Final date for completion of requirements for Graduate School degrees to be awarded September 1.

Officers of the University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
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Rufus H. Powell, LL.B., *Secretary of the University*
A. Kenneth Pye, LL.M., *University Counsel*

Officers of the Summer Session

Olan Lee Petty, Ph.D., *Director of the Summer Session*
Anne Flowers, Ed.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*
Leroy P. Smith, S.M., *Assistant Dean of Trinity College of Arts and Sciences*
Stephen C. Frederick, B.D., *Assistant Dean of Trinity College of Arts and Sciences*
Jane Philpott, Ph.D., *Assistant Dean and Dean of Undergraduate Instruction of Trinity College of Arts and Sciences*
Alan W. Jenks, Th.D., *Assistant Dean of Trinity College of Arts and Sciences*
Gerald L. Wilson, M.D., *Assistant Dean of Trinity College of Arts and Sciences*
Ellen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Howard Strobel, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
James C. Little, B.D., *Assistant Dean of Trinity College of Arts and Sciences*
Elizabeth Nathans, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Paula R. Phillips, A.B., *Assistant Dean of Trinity College of Arts and Sciences*
Richard L. Cox, Th.M., *Dean of Students*
James Douthat, B.D., *Assistant Dean of Students*
Lillian A. Lee, M.S.Ed., *Assistant Dean of Students*
Harold G. Wallace, B.D., *Dean of Black Affairs*
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
Ruby Wilson, Ed.D., *Dean of the School of Nursing*
Ella E. Shore, M.A., *Dean of Student Affairs of the School of Nursing*
George W. Pearsall, Sc.D., *Dean of the School of Engineering*
Rhett T. George, Jr., Ph.D., *Assistant Dean of the School of Engineering*
Otto Meier, Jr., Ph.D., *Assistant Dean of the School of Engineering*
Thomas A. Langford, Ph.D., *Dean of the Divinity School*
Charles William Ralston, Ph.D., *Dean of the School of Forestry*
Charles M. Harman, Ph.D., *Associate Dean of the Graduate School*
Dale B. J. Randall, Ph.D., *Associate Dean of the Graduate School*
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John Costlow, Jr., Ph.D., *Director of Duke Marine Laboratory*
Robert H. Ballantyne, Ed.D., *Director of Undergraduate Admission*
Jean F. O'Barr, Ph.D., *Director of Career and Continuing Education*
James T. Cleland, D.D., *Dean of the Chapel*
Elmer Hall, *Assistant Chaplain to the University and Associate Director of Religious Activity*
James Benjamin Smith, M.S.M., *Director of Chapel Music and Choral Music*
Walter Scott Persons, A.B., *Recreation Supervisor for the Summer Session*
Lawrence W. Smith, Jr., B.A., *Director of Housing Management*
Paul R. Benton, *Manager of Residence Halls*

The Summer Session Faculty

Adams, Anne H., Ed.D., *Associate Professor of Education*
Alt, A. Tilo, Ph.D., *Assistant Professor of German*
Anderson, Carl L., Ph.D., *Professor of English*
Aquila, Richard E., Ph.D., *Assistant Professor of Philosophy*
Austin, Joseph Harold, Jr., B.S., *Instructor in Computer Science*
Azevedo, Mario, M.A., *Instructor in History*
Baier, Rodger, Ph.D., *Assistant Professor of Chemistry*
Barber, Richard T., Ph.D., *Associate Professor of Zoology*
Beaver, Patricia D., B.A., *Instructor in Anthropology*
Benditt, Theodore M., LL.B., Ph.D., *Assistant Professor of Philosophy*
Bessent, Helga W., M.A., *Assistant Professor of German*
Bonk, James, Ph.D., *Associate Professor of Chemistry*
Bookhout, Cazlyn G., Ph.D., *Professor of Zoology*
Borinski, Ernst., Ph.D., *Visiting Professor of Sociology*
Budd, Louis J., Ph.D., *Professor of English*
Burdick, Donald S., Ph.D., *Associate Professor of Mathematics*
Butters, Ronald, Ph.D., *Assistant Professor of English*
Carbone, Peter, Ed.D., *Associate Professor of Education*
Carson, Robert C., Ph.D., *Professor of Psychology*
Cartwright, William H., Ph.D., *Professor of Education*
Clark, Henry B., Ph.D., *Associate Professor of Religion*
Clum, John, Ph.D., *Assistant Professor of English*
Coder, David, Ph.D., *Assistant Professor of Philosophy*
Colton, Joel, Ph.D., *Professor of History*
Colver, Robert M., Ed.D., *Associate Professor of Education*
Corless, Roger J., B.D., *Instructor in Religion*
Davis, Lucy, Ed.D., *Assistant Professor of Education*
deMarchi, Neil B., Ph.D., *Assistant Professor of Economics*
deNeef, A. Leigh, Ph.D., *Assistant Professor of English*
Dirlik, Arif, M.A., *Instructor in History*
Duffey, Bernard I., Ph.D., *Professor of English*
Durden, Robert F., Ph.D., *Professor of History*
Erickson, Carl, Ph.D., *Associate Professor of Psychology*
Evans, Lawrence E., Ph.D., *Associate Professor of Physics*
Fein, John Morton, Ph.D., *Professor of Romance Languages*
Ferguson, Oliver W., Ph.D., *Professor of English*

Fitzgerald, Bruce, Ph.D., *Visiting Assistant Professor of Economics*
Forward, Richard B., Ph.D., *Assistant Professor of Zoology*
Fowlie, Wallace, Ph.D., *James B. Duke Professor of Romance Languages*
Fraser, Diane, M.A., *Instructor in Sociology*
Friedrich, John A., Ph.D., *Professor of Physical Education*
Gavins, Raymond, Ph.D., *Assistant Professor of History*
Gehman, Ila, Ed.D., *Associate Professor of Medical Psychology*
Gehman, W. Scott, Jr., Ph.D., *Professor of Psychology in Education*
Gilmore, Virginia, M.A., *Instructor in Sociology*
Githens, Sherwood, Jr., Ph.D., *Professor of Education*
Goodwyn, Lawrence, Ph.D., *Adjunct Assistant Professor of History*
Gorman, John A., Ph.D., *Visiting Associate Professor of Psychology*
Graham, Daniel A., Ph.D., *Assistant Professor of Economics*
Gutknecht, John, Ph.D., *Assistant Professor of Physiology*
Guttman, Norman, Ph.D., *Professor of Psychology*

Hagadorn, Irvine R., Ph.D., *Professor of Zoology*
Hagerman, Robert L., M.B.A., *Instructor in Management Sciences*
Hagler, Ellis P., *Instructor in Physical Education*
Hall, Hugh Marshall, Ph.D., *Professor of Political Science*
Han, Moo Young, Ph.D., *Associate Professor of Physics*
Hartwig, Gerald W., M.A., *Assistant Professor of History*
Havrilesky, Thomas, Ph.D., *Associate Professor of Economics*
Henson, C. Ward, Ph.D., *Assistant Professor of Mathematics*
Heron, S. Duncan, Jr., Ph.D., *Professor of Geology*
Hodel, Richard Earl, Ph.D., *Associate Professor of Mathematics*
Hosier, Paul, Ph.D., *Visiting Assistant Professor of Biology*
Hull, Alexander, Ph.D., *Associate Professor of Romance Languages*
Hurlburt, Allan S., Ph.D., *Professor of Education*
Johns, Sheridan Waite III, Ph.D., *Associate Professor of Political Science*
Johnson, Charles B., Ed.D., *Associate Professor of Education*
Jones, Barney L., Ph.D., *Associate Professor of Religion*
Jones, Buford, Ph.D., *Associate Professor of English*
Katzenmeyer, William G., Ed.D., *Associate Professor of Education*
Klabes, Günter, B.A., *Temporary Instructor in German*
Kort, Wesley, Ph.D., *Associate Professor of Religion*
Kramer, Richard B., Ph.D., *Assistant Professor of Psychology*
Kremen, Irwin, Ph.D., *Assistant Professor of Psychology*
Kuhn, Arthur J., Ph.D., *Assistant Professor of Business Administration*
Landeira, Richard, Ph.D., *Assistant Professor of Romance Languages*
Lawrence, Bruce B., B.D., *Assistant Professor of Religion*
Leach, Richard H., Ph.D., *Professor of Political Science*
LeBar, John, M.S., *Instructor in Physical Education*
Lerner, Warren, Ph.D., *Associate Professor of History*
Letro, Robert, M.A., *Visiting Instructor in Education*
Ludt, Robert, Ph.D., *Visiting Assistant Professor of Chemistry*
Lukas, Victor Thomas, B.A., *Instructor in Anthropology*
Lynts, George W., Ph.D., *Associate Professor of Geology*
MacKichan, Barry B., Ph.D., *Assistant Professor of Mathematics*
Markman, Sidney D., Ph.D., *Professor of Art History and Archaeology*
Martin, David V., Ed.D., *Associate Professor of Education*
McAnulty, Michael, Ph.D., *Instructor in Computer Science*
McCollough, Thomas E., Th.D., *Associate Professor of Religion*
McGillis, Daniel, B.A., *Instructor in Psychology*
Mellown, Elgin W., Jr., Ph.D., *Associate Professor of English*
Monsman, Gerald C., Ph.D., *Associate Professor of History*
Moore, Lawrence C., Jr., Ph.D., *Assistant Professor of Mathematics*
Mueller, Julia Wilkinson, M.A., *Professor of Music*
Mulligan, Winifred, M.A., *Visiting Instructor in History*
Murray, James C., Ph.D., *Assistant Professor of Romance Languages*
Nathans, Sydney H., Ph.D., *Assistant Professor of History*
Newton, Francis, Ph.D., *Professor of Latin*
Niess, Robert, Ph.D., *Professor of Romance Languages*
Novak, Richey A., Ph.D., *Assistant Professor of German*
Nygard, Holger, Ph.D., *Professor of English*
Oates, John F., Ph.D., *Professor of Classical Studies*
Osborn, Robert Tappan, Ph.D., *Professor of Religion*
Partin, Harry B., Ph.D., *Associate Professor of Religion*
Patrick, Merrell, Ph.D., *Associate Professor of Computer Science*
Persons, W. S., A.B., *Associate Professor of Physical Education*
Petty, Olan, Ph.D., *Professor of Education*
Pilkey, Orrin H., Ph.D., *Associate Professor of Geology*
Pittillo, Robert A., Jr., Ed.D., *Associate Professor of Education*
Poteat, William H., Ph.D., *Professor of Religion*
Reardon, Kenneth James, M.A., *Associate Professor of English*
Rolf, Robert T., M.A., *Instructor in History*
Salinger, Herman, Ph.D., *Professor of German*
Salmon, Michael, Ph.D., *Visiting Associate Professor of Zoology*
Searles, Richard B., Ph.D., *Associate Professor of Botany*

Shuman, R. Baird, Ph.D., *Professor of Education*
Silberman, Bernard, Ph.D., *Professor of History*
Simpson, Ida, Ph.D., *Associate Professor of Sociology*
Smith, David Alexander, Ph.D., *Associate Professor of Mathematics*
Smith, Grover C., Ph.D., *Professor of English*
Spragens, Thomas, Ph.D., *Assistant Professor of Political Science*
Steegar, David, M.A., *Instructor in Romance Languages*
Stern, Henry R., Ph.D., *Assistant Professor of German*
Stewart, Philip, Ph.D., *Associate Professor of Romance Languages*
Sublett, Henry L., Jr., Ed.D., *Associate Professor of Education*
Sullivan, James B., Ph.D., *Assistant Professor of Biochemistry*
Sutherland, John, Ph.D., *Assistant Professor of Zoology*
TePaske, John, Ph.D., *Professor of History*
Troy, Joan B., Ed.D., *Instructor in Education*
Tuthill, Richard, Ed.D., *Professor of Economic Geography*
Vernon, John M., Ph.D., *Associate Professor of Economics*
Vogel, Ronald John, M.A., *Instructor in Sociology*
Ward, Calvin L., Ph.D., *Associate Professor of Zoology*
Warner, Seth L., Ph.D., *Professor of Mathematics*
Welsh, Paul, Ph.D., *Professor of Philosophy*
Wells, Richard L., Ph.D., *Associate Professor of Chemistry*
White, Richard A., Ph.D., *Associate Professor of Botany*
White, Suzanne, M.A., *Instructor in Physical Education*
Wilder, Pelham, Jr., Ph.D., *Professor of Chemistry*
Williams, George W., Ph.D., *Professor of English*
Wilkinson, William E., Ph.D., *Assistant Professor of Mathematics*
Wintermute, Orval, Ph.D., *Associate Professor of Religion*
Wolfe, James F., Ph.D., *Visiting Associate Professor of Chemistry*
Woodbury, Max A., Ph.D., *Professor of Computer Science*
Yohe, William P., Ph.D., *Professor of Economics*
Young, Charles R., Ph.D., *Professor of History*

1

General Information

The Summer Program at Duke

The summer session at Duke University makes available to Duke students, to students from other universities and colleges, to teachers in elementary and secondary schools, and to other special students a notable program of instruction in many fields of knowledge, both academic and professional.

Course programs offered during the summer are designed to meet special and particular needs as well as the more conventional requirements leading to specific degrees.

Postdoctoral research scholars may find the regular summer session courses useful for further study. The library facilities and the various laboratories may be valuable for postdoctoral residents.

Graduate students who have been admitted to the Graduate School to study for the Master of Arts, Master of Education, and Master of Arts in Teaching degrees will find courses arranged in sequence from summer to summer to meet their requirements.

Teachers from elementary and secondary schools who desire to earn credits toward the renewal of their certificates and who are interested in further teacher training in subject content and method may enroll in senior-graduate courses as special or unclassified students.

Undergraduates of Duke University who desire to accelerate their programs may complete the work for a degree in three years by attending two or more summer sessions.

Undergraduates from other colleges and universities may enjoy the special advantages of summer instruction at Duke and transfer credits earned to their own institutions.

Although the summer course program meets, in many departments, the needs of degree candidates, it goes beyond these limits in also presenting courses of wide general interest and, in addition, special non-credit lectures, conferences, institutes, and workshops.

Duke University's ample and modern research facilities will be available during the summer to all properly qualified students. It is the hope of the University, of the summer faculty, and of the administrative officers that former students and new students will find increasing values in each summer spent at Duke.

2

Program Information

Undergraduate Study

Students in the undergraduate college and schools of Duke University who desire to enrich or accelerate their academic study will find summer programs to meet their individual needs and interests. Special courses are provided which are not otherwise available to undergraduates; election of the usual courses may relieve an overload during the fall or spring terms; and, summer programs also enable some students to attain provisional graduate status in the senior year or to graduate in less than four years.

By attending at least two terms of the summer session, it is possible for a student to earn credit for as many as four semester-courses. Instruction will be offered in the summer of 1973 in most departments and colleges. Specific requirements for degrees offered in the undergraduate colleges and schools may be obtained from the *Bulletin of Undergraduate Instruction.*

Divinity School Studies

The degrees of Master of Divinity and Master of Religious Education are administered by the faculty of the Divinity School. Students in these programs may register with the Summer Session Office for independent study in any one of the terms of the summer session. Persons desiring credit toward one of these degrees must be regularly admitted to the Divinity School and all courses taken by the student for Divinity School credit must be registered and approved by the Director of Academic Affairs of the Divinity School.

Graduate Study

Degrees and Requirements. The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Hospital Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.). Specific requirements relative to admission, residence, major and related studies, languages, and thesis requirements may be obtained from the *Bulletin of the Graduate School.*

Candidates for degrees in the Graduate School desiring to have their degrees conferred on September 1 must have completed all requirements for the degree as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree officially conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 15.)

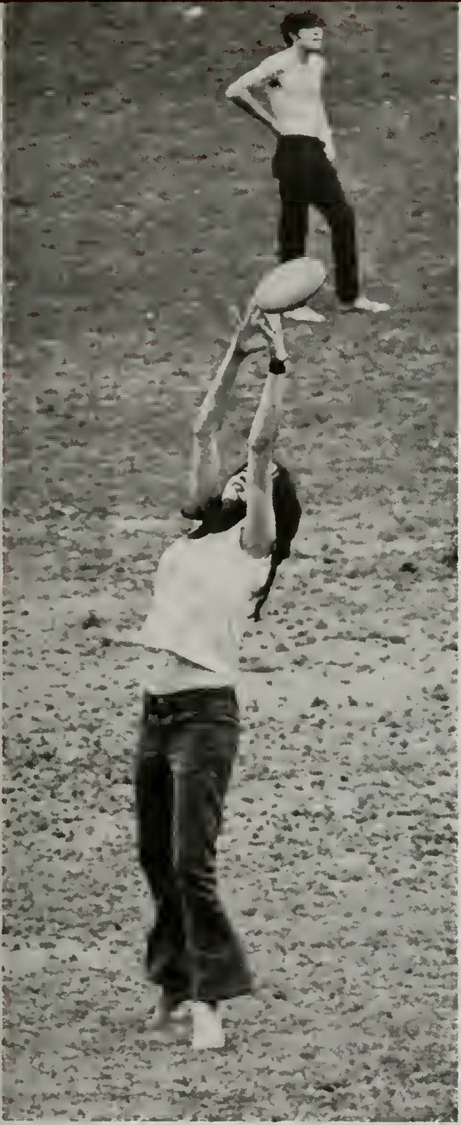
Summer Program for Graduates. Summer sessions offer an excellent opportunity to advance or complete programs of graduate study already undertaken, to begin study toward a graduate degree at Duke University, to acquire graduate training useful in professional advancement, or to study for personal satisfaction. The several departments offer a variety of graduate courses, as listed in later pages, given by members of the Duke faculty and visiting professors.

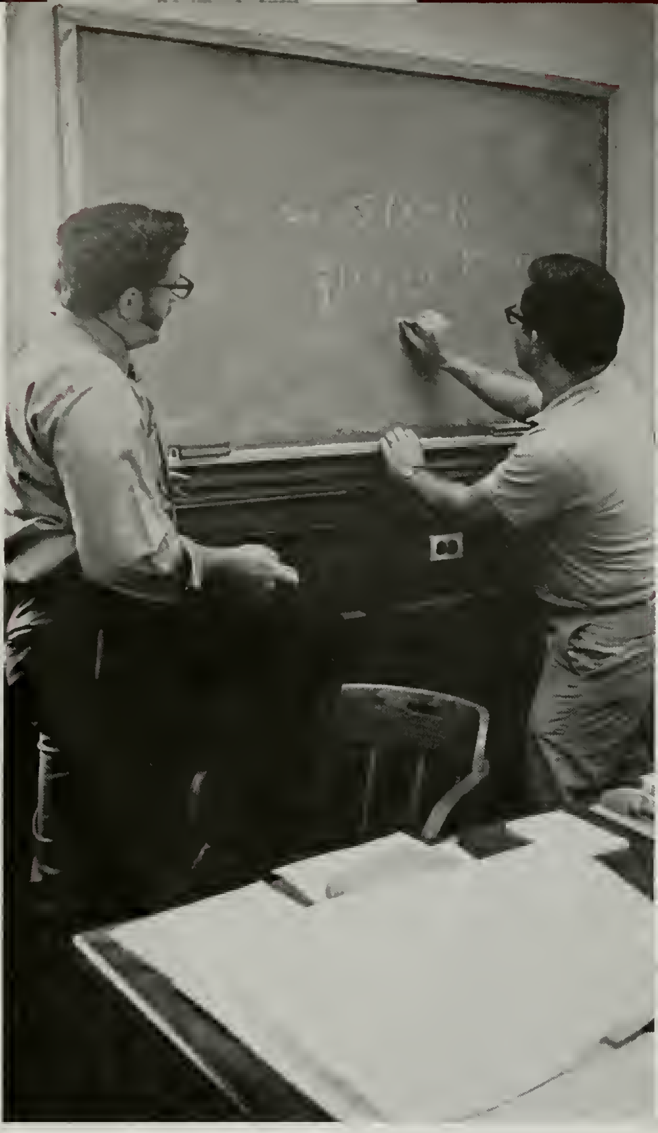
Unclassified Graduate Students. Any student who holds an A.B. or B.S. degree and who does not intend to earn an advanced degree at Duke University but who desires graduate work for professional or other reasons should apply to the Director of the Summer Session for admission as an unclassified student. Credits earned by an unclassified graduate student in graduate courses taken at Duke before his admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed six units, and (4) the work is of *G* level or better. This policy shall be effective with students entering the Graduate School in September, 1971.

Cooperative Program in Teacher Education. Thirty-five to forty selected graduates of liberal arts colleges who desire to prepare for high school teaching will be admitted to a special internship program at Duke University. This program is designed to prepare for a teaching career selected college graduates who did not prepare professionally for teacher certification as undergraduates. The cooperative program provides, for candidates who are chosen, graduate study in their special fields, professional courses, and carefully supervised observation and teaching experiences. One who completes the program successfully can achieve, within a period of fifteen months, a year of teaching experience, a Master of Arts in Teaching degree, and full certification as a teacher.

Candidates will begin the program at the opening of Term II of the 1973 Summer Session and complete it in August 1974. They will spend two terms of the summer preceding and the summer following the year of teaching in residence at the University. During the school year 1973-74 interns will be employed as regular teachers in cooperating public school systems. During this year they will receive full salary and will work under the joint supervision of the cooperating public school and the University. The program will meet training qualifications for the advanced or graduate teacher's certificate in many states. Participants in the program are expected to teach for a second year as fully certified teachers in the school in which they complete the internship.

The salary for the year of teaching will, in effect, constitute a substantial award to candidates selected for the program. Interns will benefit from Duke Uni-

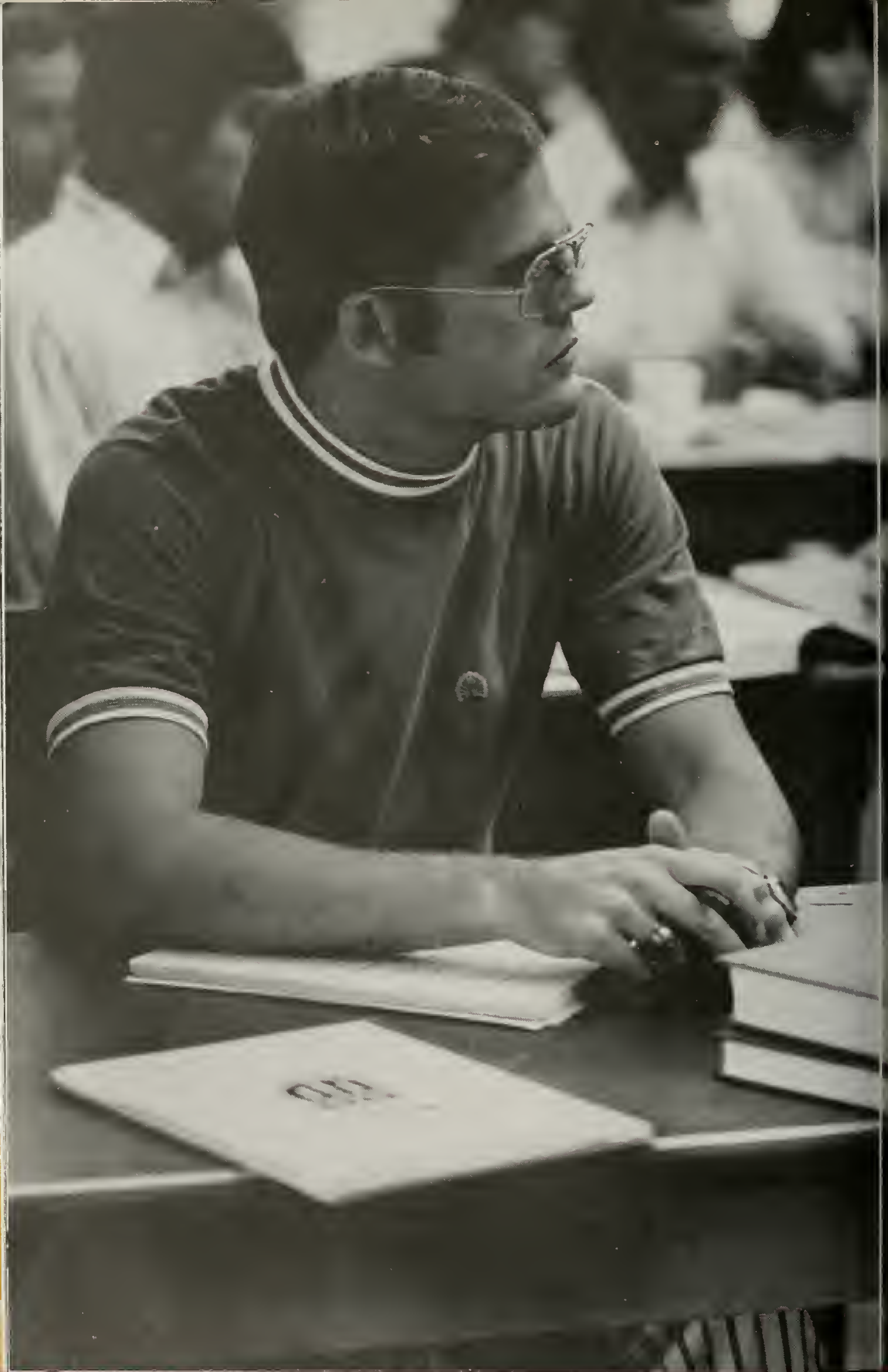




versity's special tuition rate for teachers. Applicants will be considered, as are candidates for other awards, on a competitive basis. The best qualified applicants will be chosen on the basis of undergraduate record, recommendations, and evidence of interest in becoming high-school teachers. Applicants are required to arrange interviews in connection with their applications. Application forms may be requested from the Dean of the Graduate School and should be submitted before February 15, 1973. Details concerning the program can be obtained by writing the Director, Cooperative Program in Teacher Education, Department of Education, Duke University.

Postdoctoral Research

Scholars engaged in postdoctoral research find it advantageous and sometimes essential to use the resources of the Duke University libraries during the summer. The University welcomes these visitors and makes living accommodations (dormitory space and dining facilities) available to them during the summer sessions from May 14 to August 24.



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Special and Cooperative Programs

Cooperative Program

The long standing reciprocal agreement between Duke and the University of North Carolina is now effective for the summer sessions at both universities. To take advantage of this arrangement for either term of the summer session, the eligible student registers each term for three units of credit at the home institution and three units representing the course to be taken at the other institution, for a total of six units. A nominal registration fee of $2 will be charged at the other institution. Credit so earned is not defined as transfer credit. This program applies to both graduate and undergraduate students.

Special Conferences and Courses

Special Programs for Teachers of Science and Mathematics. It is anticipated that the summer session will offer a number of special programs at the graduate level designed specifically for high school teachers of science and mathematics. For detailed information on the programs, teachers should write Dr. Sherwood Githens, Education Department, Duke University, Durham, North Carolina 27708.

Highlands Biological Station. Duke University holds a subscribing instructional membership in the Highlands Biological Station at Highlands, North Carolina, on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The situation and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in botany and zoology may make arrangements to carry out research at this station.

Medical Mycology. A month's course in medical mycology, under the direction of Dr. Norman F. Conant, is to be offered through the Duke Medical Center from July 2-28, 1973. The course will be offered every day in the week, except

Sunday, and has been designed to ensure a working knowledge of the human pathogenic fungi within the time allotted.

Emphasis will be placed on the practical aspects of the laboratory as an aid in helping establish a diagnosis of fungus infection. Insofar as possible and as patients become available, methods of collecting materials in the clinic for study and culture will be stressed. Work with patients, clinical material, cultures, and laboratory animals will serve as a basis for this course. Also, an opportunity to study pathologic material, gross and microscopic, will be given to those students whose previous training would allow them to obtain the greatest benefit from a study of such material.

The enrollment for the course will be limited and the applications will be considered in the order in which they are received. An attempt will be made, however, to select students on the basis of their previous training and their stated need for this type of work.

A fee of $200.00 will be charged for this course, upon the completion of which a certificate will be awarded. However, an applicant upon acceptance into the course may register with the Summer School, pay its fees instead of the fee stated above, and receive four units of graduate credit for the course. Please direct all inquiries to Dr. Norman F. Conant, Professor of Microbiology, Duke University Medical School, Durham, North Carolina 27706.

The Ministerial Course of Study School. In cooperation with the Board of Education and the Southeastern Jurisdictional Conference of the United Methodist Church, Professor Paul A. Mickey directs the Ministerial Course of Study School. This is not related to the regular Divinity School degree program and no credit toward a seminary degree can be earned. The twenty-fifth session of the school is from June 25-July 20, 1973. For further information write the Director, Box 4484, Duke Station, Durham, North Carolina 27706.

Divinity School Summer Institute for Ministry. Seminars and clinics, running concurrently, for ministers, wives, and church leaders of all denominations will be conducted at the Duke Divinity School, July 2-12. These are designed to supplement seminary education through two weeks of intensive training in one selected subject. No academic credit is given. Participants are expected to attend each session from the opening dinner to the closing luncheon.

Sponsoring institutions make available funds for tuition. Other scholarships are available upon request. For full information write to: Director of the Summer Institute for Ministry, Duke Divinity School, Durham, North Carolina 27706.

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Resources for Study

Libraries

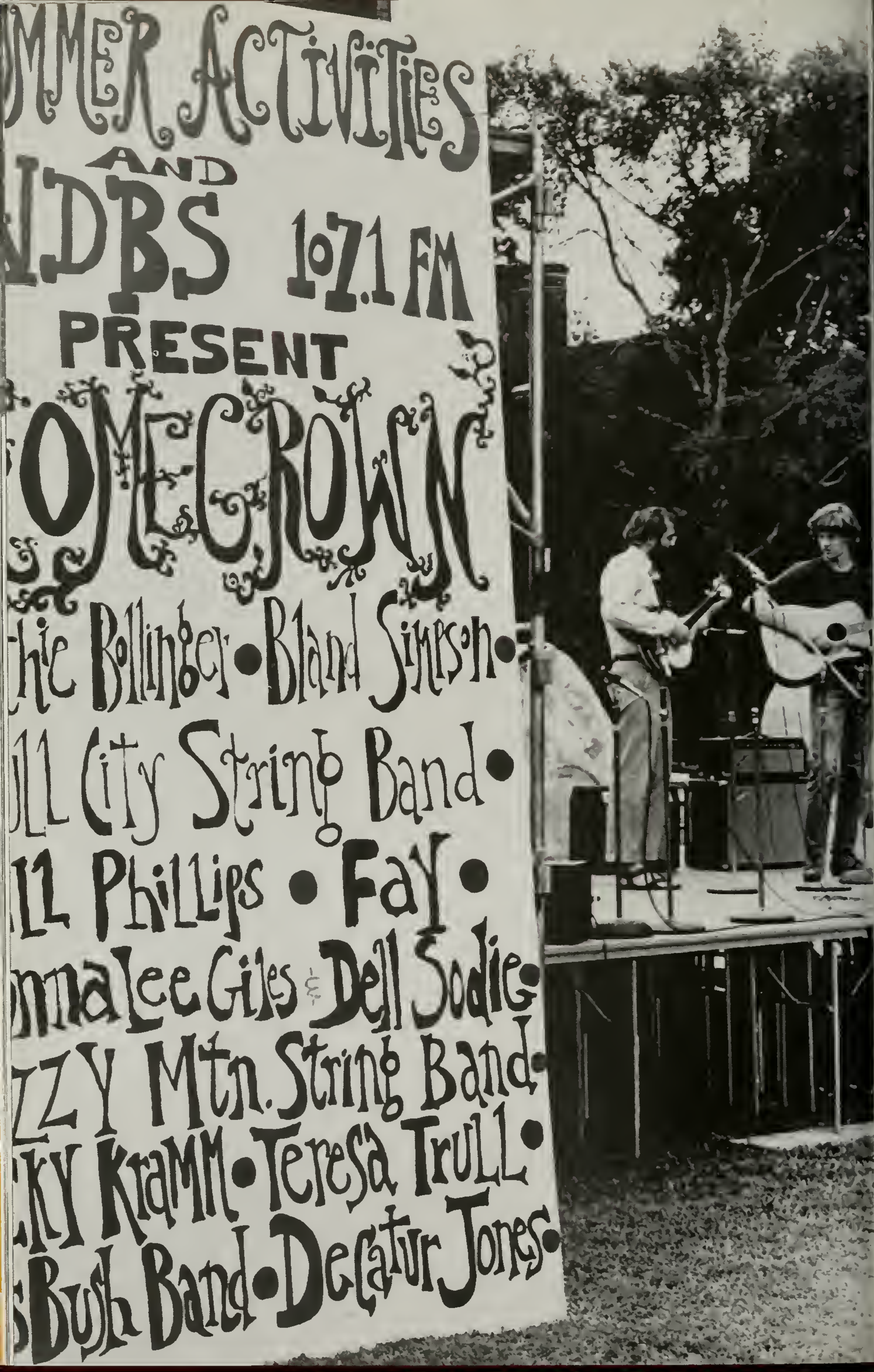
The William R. Perkins Library consists of the new research library building which was opened early in 1969 and the old building, which was renovated in 1970. The complex has about 2,100 seats, 700 of which are private carrels, and shelf space for 2,500,000 volumes.

On June 30, 1972, the university libraries, including nine school and six departmental collections, contained 2,333,382 volumes and more than 4,100,000 manuscripts. One hundred and ten thousand volumes were added during the year and 14,471 periodicals are received regularly. Many rare and perishable materials which appeared in books, newspapers, periodicals, and manuscripts are available in microtext form and may be read in a special microtext reading room in the Perkins Library. Rare books and manuscripts have special quarters in the building, which are accessible to all members of the University community.

All libraries of the University are open for use throughout the summer. Guides to the Perkins Library for faculty, graduate students, and undergraduate students are available upon request to the University Librarian, Perkins Library, Duke University, Durham, North Carolina 27706.

Laboratories

The laboratories in the various science departments (Botany, Chemistry, Physics, Psychology, and Zoology) are designed for both teaching and research. Ideal locations for special work in some of the sciences are available at Duke University Marine Laboratory at Beaufort, North Carolina; at Highlands Biological Laboratory at Highlands, North Carolina; in the Duke Forest at Durham, North Carolina; and in the Sarah P. Duke Gardens on the West Campus of Duke University.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KY Kramm • Teresa Trull •
s Bush Band • Decatur Jones •

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Student Life

Living Accommodations

Housing. To provide maximum comfort and pleasant surroundings, the residence hall facilities in Few and Edens Quadrangles on West Campus are used to house most summer session students. Houses in Few Quadrangle are reserved for regularly enrolled undergraduate men and women. Graduate men and women may be assigned to Edens if necessary. Accommodations in the University's Town House Apartments (located about one mile from the center of the campus) and Duke-leased apartments in Duke Manor (three miles from campus) are also available to graduate students and some married couples or families with no more than four persons. Town House and Duke-leased units will not be available for any period less than one summer term. The facilities are air-conditioned.

Residence hall accommodations are not available for married couples or families. Students with families may seek assistance in obtaining other University housing or off-campus housing by contacting the Manager of Apartments and Property. Department of Housing Management. Duke University, Durham. North Carolina 27706.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives, or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students.

The majority of residence hall rooms at Duke University are double rooms furnished for two persons. The limited number of single rooms are assigned in order of receipt of application with the required residential fees at the Department of Housing Management. No double room may be reserved for single occupancy.

Furnishings–Few and Edens Quadrangles. Each student will be provided with a glide-out bed, desk with chair, dresser, mirror, wastebasket, and adequate closet space. Each student should provide a desk lamp, bedspread, sheets, blanket, pillow, and other items desired. Beds measure 80 inches by 30 inches.

Furnishings–Town House Apartments and Duke-leased Apartments. Each attractive apartment is equipped for three persons and includes living room, kitchen, master bedroom (for two students), a single bedroom (one student), and a master bath with tub and shower. Housekeeping supplies, kitchenware, and linens must be provided by the occupants. The Town House Apartments have an additional half bath.

Dining Service. Food service is cafeteria style. The cost of meals runs from $2.50 to $3.00 per day, depending on the needs and tastes of the individual. Only the dining facilities on the West Campus will be used for the regular summer session students. The cafeteria in the Men's Graduate Center is usually not open in the summer.

Duke University Marine Laboratory. The Duke University Marine Laboratory, located on Pivers Islands, has cottage-type residence halls which will be available for summer session students. Further information may be obtained from the *Bulletin of the Duke University Marine Laboratory*.

Services Available

Medical Care. The Student Health Service, in the Marshall I. Pickens Rehabilitation Center, operates during the summer session and offers exactly the same medical and surgical services available to each full-time student during the academic year, as described completely in the *Bulletin of Information and Regulations* except for hospitalization in the University Infirmary. The Infirmary facilities are closed during the summer sessions.

The Student Mental Health Service is located in the Pickens Rehabilitation Building on Erwin Road. The interest of the Student Mental Health Service is the emotional well-being of the Duke student body. The service provides evaluation and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Student Mental Health Service records are maintained separately and are not a part of any other record system, academic or medical. Contact with the service is strictly confidential.

No illness is treated in the dormitory or other rooms occupied by students.

A student must present the 1973 summer session student identification card as evidence that he is matriculated in the summer session and entitled to care at the Student Health Service in the Marshall I. Pickens Rehabilitation Building.

Regular Clinic services are available for use from 8 a.m. to 8 p.m. Monday thru Saturday and from 2 p.m. to 8 p.m. Sunday at the University Health Clinic, Pickens Building, West Campus, Duke extension 7621.

For emergency problems (when the University Health Clinic is not open), the emergency room at Duke Hospital (Duke Extension 2413) is available. The financial responsibility for expenses incurred in the Emergency Room rests with the student and his parents, though it is anticipated that most, if not all, such services will be covered under the Duke Student Accident and Sickness Insurance Policy or the student's personal accident and sickness insurance policy. This Duke Student Accident and Sickness Insurance Policy will cover only true emergencies necessitating treatment at the Hospital Emergency Room. The Emergency Room Business Office will assist in filing claims under this and other health insurance policies.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for any and all services

received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The Student Health Program does not provide health care for spouses and dependent children of married students. There are provisions in the Insurance Plan, however, for coverage of the married student's family. Pre-existing conditions of dependent spouse and/or children are not covered.

The University expects all students to be financially responsible for medical expenses beyond those covered by the University Student Health program through supplemental accident and sickness insurance policies or their own personal financial resources.

These rules and regulations are those in effect at the time of publication of this document, but are subject to change at a later date.

The University Counseling Center. The University maintains a University Counseling Center which provides a centralized program of educational, vocational, and personal counseling for students. This confidential counseling service on problems of personal, social, educational, and vocational adjustment is provided without cost to students enrolled at the University. In addition, the center administers special group testing programs for University schools and departments and serves as the local testing center for a wide variety of national testing programs. The center also carries on programs of research in the field of measurement and counseling. Although the counseling, testing, and research services of the center are designed primarily to meet the needs of the students, faculty, and staff of Duke University, these services are made available to individuals and organizations outside the University as its facilities permit. Requests for further information should be addressed to the Director, University Counseling Center, 309 Flowers, Duke University, Durham, North Carolina 27706.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to students in the summer session who are registered for a degree at Duke University. The staff is available to talk with summer session students about their professional plans and with school officials who may be seeking the services of new teachers. Students who are eligible to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated during the time a student is enrolled at Duke. Copies of academic records are released only with the permission of the individual.

Student Activities

Religious Life. Christian services of worship are conducted in the Univer-

sity Chapel every Sunday of the year, including those which fall during the summer. The hour of the service is eleven o'clock. Preachers representing all branches of Christendom appear in the pulpit, and they are drawn from every quarter of the globe. Choral music for these services is provided by a choir composed chiefly of student volunteers.

Recreation and Activities. The summer session will provide a varied program of entertainment and recreation. The program includes movies, dances, and open house socials. Tours to areas of interest can be arranged for weekends. Both the mountains and the seashore are easily accessible. Adequate facilities are available for those interested in swimming, tennis, and other sports. Clubs organized for the summer play an active part in all social activities and recreation.

Publications

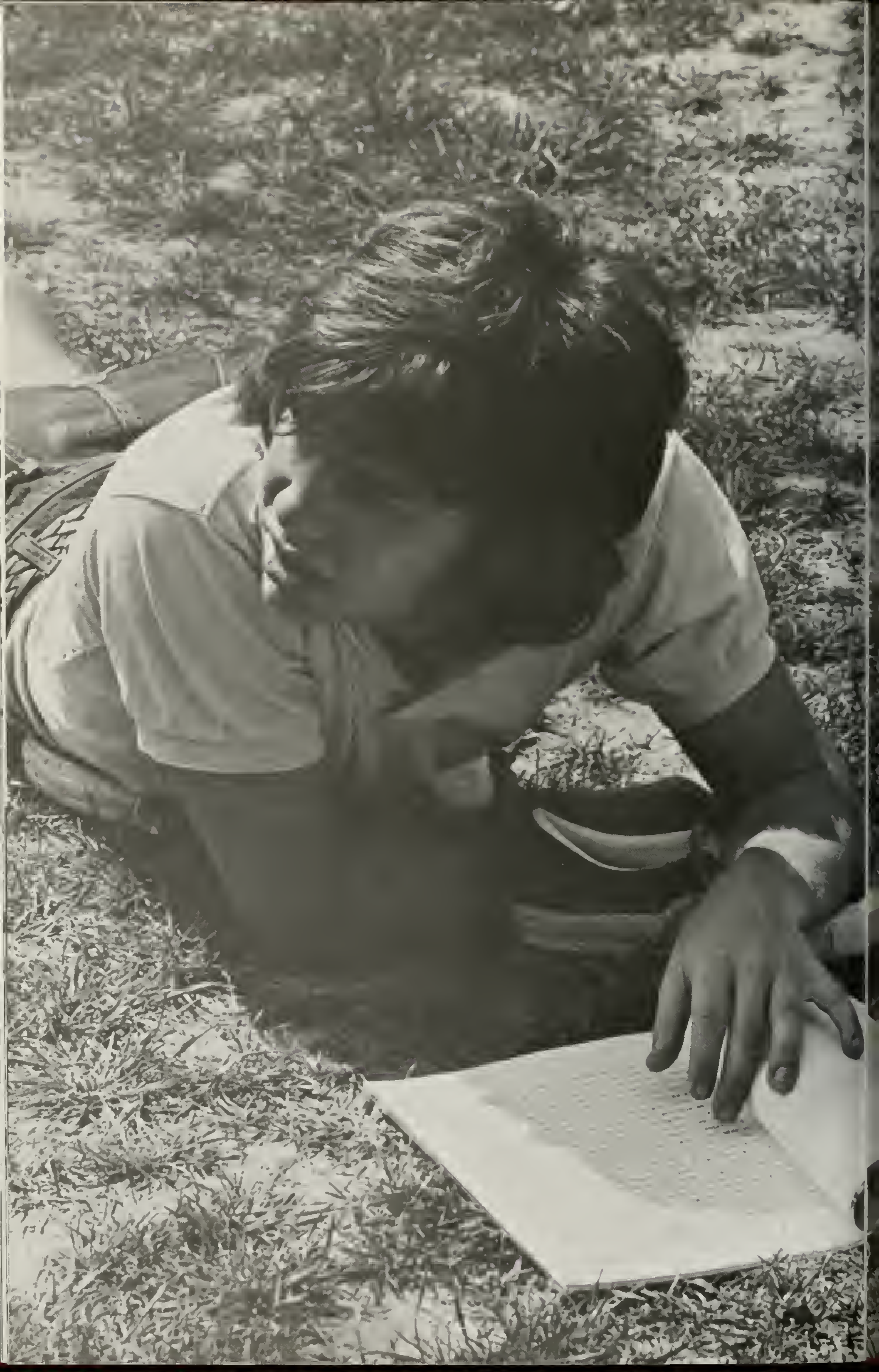
During the summer session the University will publish each Saturday *The Duke University Calendar,* an official calendar announcing events—academic, social, and recreational—of the following week. This calendar also includes official notices concerning academic requirements. Students are expected therefore to read the *Calendar* regularly.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, from time to time, are put into effect by the appropriate authorities of the University. The student is expected to be familiar with the current *Bulletin of Information and Regulations* as well as any published regulations for the summer session.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University. University authorities will take action in accordance with academic due process.



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Admission

Qualifications for Admission

Students in the following categories may be admitted to the Duke University Summer Session:

1. Graduates and undergraduates who are presently enrolled and in good standing in Duke University.
2. Graduates and undergraduates who have been formally admitted or readmitted to Duke University.
3. Students who are currently in good standing at their respective institution and who have approval by the proper authority to take and transfer credits earned in the Duke Summer Session.
4. Teachers in service with or without the bachelor's degree who wish to earn credits for certification purposes.

Admission to specific courses offered in the summer session is governed by the student's academic status (freshman, sophomore, junior, senior, graduate, special, or unclassified) and by the prerequisites of the course in question. All applicants will be considered without regard to race, color, religion, sex, or national origin.

Application Procedures

Duke Students in Residence during the Spring Semester, 1973. A Duke University student, either graduate or undergraduate, who plans to attend the summer session should at the time of preregistration for the fall semester (see page iv for specific dates) enroll for the desired summer session courses. He need not file with the Summer Session Office the application blank at the end of this *Bulletin*.

Undergraduates Not in Residence at Duke during the Spring Semester, 1973. New students seeking to enter Duke University as freshmen or as undergraduates with advanced standing, and undergraduates who wish to re-enter the University, should write the Office of Admissions requesting application forms.

Undergraduates, both men and women, enrolled in other colleges and universities who desire to earn in the Duke University Summer Session credits which are to be transferred to their own institutions should apply directly to the Director of the Summer Session, Duke University, on the application form at the end of this *Bulletin*. They should give accurately and clearly all information called for on the application form.

Graduates Not in Residence at Duke during the Spring Semester, 1973. Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School *must also file* Graduate School application forms which may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

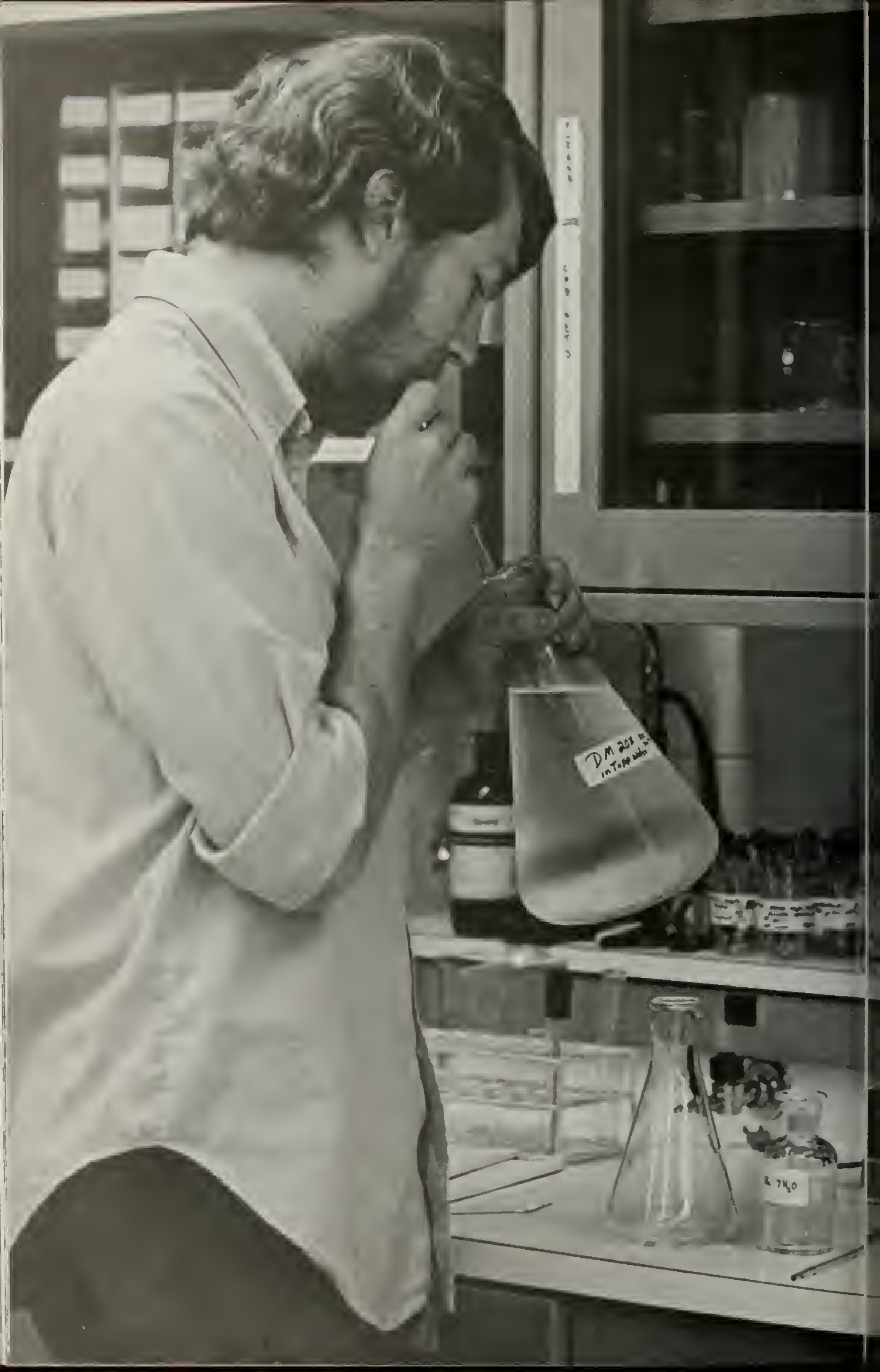
Students with graduate standing and currently employed as teachers who wish only to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 4 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application at the end of this *Bulletin* may be used.

Postdoctoral Scholars. Application for these postdoctoral research privileges must be made in advance by letter to the Director of the Summer Session giving the applicant's present position, the specific field of his research interest, and the dates during which he desires to be in residence. Approved applicants will be accepted subject to the availability of library and dormitory space.

Admission to Degree Candidacy

Undergraduates. A student seeking to enroll as a candidate for the bachelor's degree from a college or school of Duke University must meet the entrance requirements set forth in the *Bulletin of Undergraduate Instruction* and be accepted by the Director of Admissions. This *Bulletin* may be secured by writing the Office of Admissions, Duke University.

Graduates. A student seeking to enroll as a candidate for one of the advanced degrees offered by the Graduate School of Duke University must meet the requirements set forth in the *Bulletin of the Graduate School*. This *Bulletin* may be secured by writing to the Office of the Graduate School, Duke University.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Financial Information

Tuition and Fees

The University Tuition. The following charges will cover registration and medical care:

1. Tuition for undergraduates—$195.00 for each nonlaboratory course, $260.00 for each undergraduate laboratory course, and $390.00 for each two-course program offered at the Duke Marine Laboratory.
2. Tuition for graduate students—$65.00 per unit; for an undergraduate course, the tuition rate is indicated in paragraph 1 above.
3. Teachers in full-time service in elementary and secondary schools, except teachers pursuing a doctoral program at Duke—one-half of the tuition charges specified in paragraphs 1 and 2 above.
4. All students pursuing a doctoral program (post-master's) at Duke—fees as specified in paragraphs 1 and 2.
5. Divinity School students approved by the Dean of that school—one-half of the tuition charge specified in paragraph 1 and 2 above, when the course is a requirement for the student's program.

Laboratory Fees. For Marine Laboratory investigators' research table fee, see the *Marine Laboratory Bulletin.*

Medical Mycology Fee. This fee of $200.00 replaced the University tuition.

Master's Degree Summer Session Tuition. A master's candidate who submits his thesis when not registered for at least 1 unit of research-residence tuition is required to pay the 1-unit tuition of $65.00.

Auditing Fees. These fees are as follows:

1. Students registered for a full course program may audit nonlaboratory courses (with the permission of the Director) at no extra charge.
2. Students carrying less than a full course program may be granted permission to audit a course but he will pay half the University fee for the course.

Late Registration Fee. Students who fail to register prior to the first class day of a given course will pay an extra fee of $10.00.

Fee for Course Changes. Course changes other than those required by the University will be made only on payment of an extra fee of $1.00 per change.

Fee for Make-up Final Examination. This fee is $5.00.

Refund for Tuition and Fees. Tuition and fees will be refunded under the following circumstances:

1. When applications for withdrawal are received by the Director of the Summer Session on or before the Friday preceding the Monday on which classes begin for a given term of the summer session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the Director of the Summer Session during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the Director of the Summer Session after the fourth class day, there will be no refund of tuition and fees.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Living Accommodations

UNDERGRADUATE AND GRADUATE RESIDENCE HALLS

Few and Edens Quadrangles

Single	Double
15 weeks—$322.50	15 weeks—$240.00
10 weeks—$215.00	10 weeks—$160.00
9 weeks—$193.50	9 weeks—$144.00
8 weeks—$172.00	8 weeks—$128.00
5 weeks—$107.50	5 weeks—$ 80.00
4 weeks—$ 86.00	4 weeks—$ 64.00
1 week —$ 21.50	1 week —$ 16.00

TOWN HOUSE APARTMENTS (GRADUATE STUDENTS)*
DUKE-LEASED APARTMENTS (ALL STUDENTS)

$22.00 each student per week (three to an apartment)
$33.00 each student per week (two to an apartment)

* Not assigned for less than four weeks. Air-conditioned. Special rates will be quoted for families. A $50 residential deposit is required of families occupying apartments.

DUKE UNIVERSITY MARINE LABORATORY

Each Term, Per Person

Double Room (Non-Air-conditioned)	$59.00
Double Room (Air-conditioned)	$75.00
Triple Room (Air-conditioned)	$54.00

Housing Procedures. Application for room or apartment reservations at Duke University, accompanied by the full amount of the room rent for the application period, should be made to Department of Housing Management, Duke University, Duke Station, Durham, North Carolina 27706. Rooms and spaces in apartments will be reserved in the order in which applications with full payment of fees are received and on certification of admission by the Director of Summer Session. Notification of assignment to rooms will be made about April 20 for the first term, about May 30 for the second term, and about July 1 for the third term.

Rooms and apartments are available to applicants at noon on the Sunday before the first day of classes for each summer term. A room or apartment must be vacated by the occupant before 5 p.m. on the last day of the final examination period for each session or on the final day of the agreement period, as appropriate. Any period of occupancy, other than for a specific term of the summer session, must be arranged with the Department of Housing Management, House D, Room 101-R, Duke University.

Refund of Housing Fees. Refunds are made under the following circumstances:

1. When notification for a housing cancellation is received by Department of Housing Management on or before twenty days prior to the first day of scheduled classes of the summer session term, full housing fees will be refunded.
2. When notification for a housing cancellation is received between the twenty days prior to the first day of scheduled classes and the first two class days, 80 percent of the housing fee will be refunded.
3. When notification for a housing cancellation is received after the first two days of a summer session term, 70 percent of the housing fee for the unused period will be refunded.

If a preference of roommate is desired, this information should be shown on the application form. If no preference of roommate is expressed, the Department of Housing Management will assign a roommate.

Detailed information pertaining to administration of living facilities at the Duke University Marine Laboratory may be found in the *Bulletin of the Marine Laboratory*.

Estimated Cost of One Term of the Summer Session

University tuition, two nonlaboratory courses or 6 graduate units	$390.00*
Residence Hall Fees (double room for five weeks)	80.00
Meals (cafeteria selective; average per day, $2.50)	90.00†
Books and class materials (average)	18.50†
Miscellaneous (laundry, etc.)	19.00†
Total	$597.50

* Teachers, elementary and secondary, in full-time service (except teachers pursuing a doctoral program at Duke) pay $195.00.

† Approximate costs which will vary according to individual tastes and needs.

Student Aid

Special Tuition Rate to Teachers. Teachers in full-time service in elementary and secondary schools, except those who are pursuing a doctoral program at Duke, pay only one-half of the regular tuition charge. Teachers on leave of absence from their schools and teachers not currently employed are not eligible for this special fee.

Scholarships for Public School Personnel. Duke University will offer 27 special scholarships of $200.00 each to high school and elementary teachers on a competitive basis (not by a written examination) for the summer session of 1973.

This scholarship program is designed to encourage teachers to begin or to continue their graduate studies leading to the A.M., M.Ed., or M.A.T. degree.

Duke University will again offer five special scholarships of $225.00 each to high school and elementary administrators and supervisors. This scholarship program is designed to encourage principals and supervisors to continue their graduate studies leading to advanced degrees.

Although successful applicants for the scholarships will not be required to become candidates for a degree, they must qualify for and receive admission to the Graduate School.

All applications with supporting documents must be submitted by April 1. 1973. Selection and appointment of scholars will be completed by May 1, 1973.

Application blanks and complete information may be obtained from the Director of the Summer Session. Duke University. Durham. North Carolina 27706.

Loans. A number of loan funds have been established for the benefit of the students of Duke University. Several of these funds are available to students enrolled in the summer session. Students enrolled in the summer session *only* are not eligible. These funds are administered through a committee of officers of the University.

The committee. in approving loans. selects those students who. from the standpoint of character, scholastic attainment. and degree of financial need, are deserving of consideration.

Applicants for loans should make application to the Manager. Student Loan Office. Duke University. All applications must be initiated during the first week of each term. The granting or withholding of a loan is a matter entirely within the discretion of the Student Loan Committee. A student is expected to use all other possible means of securing financial assistance before applying for aid from a loan fund.

National Direct Student Loan Program. A limited number of loans may be made, under the provisions of the Education Amendments of 1972, to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session *only* is not eligible for consideration. Students pursuing the M.A.T. Cooperative Program are not eligible. Inquiries concerning opportunities available under this program should be made to the Manager. Student Loan Office. Duke University. Durham. North Carolina 27706.

Remission of Tuition. Children of Methodist ministers who are members of the North Carolina and Western North Carolina Conferences of the United Methodist Church are entitled to a remission of the tuition charge as are the children of fulltime ministers of all faiths serving churches in Durham County. North Carolina. This consideration is given only to the children of resident members of the two North Carolina conferences who are giving their full time to religious work. Only those students enrolled in a regular undergraduate program leading to a baccalaureate degree from the University are entitled to this benefit. Students in this group are entitled to a maximum of eight semesters of free tuition at the undergraduate level. Application for this benefit should be made to the Director of Undergraduate Financial Aid. Duke University. Durham. North Carolina 27706.

Tuition Grants. Tuition grants are available to children of faculty and qualified staff members of Duke University. Information regarding the tuition grant program may be obtained by writing to the Director of Undergraduate Financial Aid. Duke University.

8

Registration and Regulations

Definition of Terms

Registration. A student has completed registration for the summer session when:

1. His course program has been written and approved by the dean of the school or college in which he is enrolled or by the Director of the Summer Session in the case of the special or unclassified student.
2. Summer session forms have been completed properly by the student in the Summer Session Office.
3. Summer session University fees have been paid. A place in a course cannot be assured until fees have been paid. Tuition bills are not sent to the student's home.

Pre-enrollment. The term *pre-enrollment* refers only to the writing of the course program and its approval by the proper authority or by the Director of the Summer Session in the case of the special or unclassified student. Pre-enrollment alone does not constitute registration.

General Registration

In each of the three terms of the 1973 Summer Session, classes will begin on a Monday: Term I, Monday, May 14; Term II, Monday, June 18; and Term III, Monday, July 23. A student attending a given summer session term must complete his registration in the Summer Session Office, 116 Allen Building, on or before the Friday preceding the first class day of that given term: Term I, Friday, May 11; Term II, Friday, June 15; and, Term III, Friday, July 20.

A student in classes beginning on dates other than the beginning date of each of the three terms must complete his registration in the Summer Session Office before the date on which those classes begin.

Late Registration

Any student who fails to register on or before the dates specified in the preceding paragraphs will be charged a fee of $10 for the late registration. All late registrations and course changes must be completed by the end of the third class day of each term (May 16, Term I; June 20, Term II; and, July 25, Term III). All course changes must be approved by the dean of the school or college in which the student is enrolled, or, in the case of the special or unclassified student, by the Director of the Summer Session.

Since summer session courses present a program of study in more concentrated and rapid form than in the regular semesters, students are advised to register on time and to be present at all class sessions.

Advanced Registration

Students in Residence during the Spring Semester, 1973. Graduate and undergraduate students in residence at Duke University during the spring semester, 1973, who plan to enroll for courses or research in one or more terms of the 1973 Summer Session will write course programs and have them approved in their respective schools or college during the week of preregistration, April 2-5, 1973.

Graduate and undergraduate students in residence, whose course programs have been written and approved by their respective schools or college on the date indicated above, may complete their registration in the Summer Session Office, 116 Allen Building, by paying their tuition from May 1-11.

A Duke student, graduate or undergraduate, who desires to attend the summer session but did not preregister on April 2-5 should complete his registration by the Friday preceding the beginning of the term he wishes to attend.

Students Not in Residence at Duke during the Spring Semester, 1973. Students not in residence at Duke University during the spring semester, 1973—new undergraduate students seeking to enter as degree candidates, graduate students who are not candidates for an advanced degree at Duke University, graduate and undergraduate students of other colleges and universities desiring to earn credits for transfer, public school teachers, and college teachers (not advanced degree candidates)—may register by mail. Advance registration by mail includes:

1. Completion in full of the application form at the end of this *Bulletin*.
2. Admission to the summer session by the Director of the Summer Session and, in the case of a student seeking to enter Duke University as a degree candidate, admission by the admissions director to the school or college of Duke University concerned.
3. Completion in full and return of forms required by the Summer Session Office at least one week prior to the beginning of the term involved.
4. Payment of tuition by at least one week prior to the beginning of classes.

Students who have not completed their registration by mail for courses in a given term should complete their registration in the Summer Session Office, 116 Allen Building, on the Friday prior to the first class day of that given term.

Degree-Candidate Graduate Students Not in Residence during the Spring Semester, 1973. A graduate student not in residence during the spring semester, 1973, who is a candidate for an advanced degree in the Graduate School of Duke University, may complete his registration by mail if his director of graduate studies and the Graduate School Office approve the registration. The student will follow the same four steps given above. Any graduate student unable to complete registration by mail must present himself for registration in the Summer Session Office on May 11 for Term I, June 15 for Term II, and July 20 for Term III.

Registration of Graduate Students. Graduate students in residence during the spring semester will preregister for one or more terms of the summer session on April 2-5. Newly admitted graduate students who have not completed their registration by mail should present themselves for registration at the official registration periods. All graduate students are required to register both with the Summer Session Office and with the Graduate School Office.

Graduate students resident in the spring semester who intend to remain in residence during one or more of the three summer session terms without registering for course work or at least 1 unit of research must register for 1 unit to cover the cost of medical care and the use of University facilities. These units of registration will entitle students to use the Student Health Service and University's facilities during the three terms of the summer session. The master's candidate who has completed all requirements except submission of the thesis and who so registers is not charged any separate fee for submitting the thesis, but he is required to register for 1 unit.

Graduates Not in Residence at Duke during the Spring Semester, 1973. Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School must also file Graduate School application forms which may be secured by writing to the Dean of Graduate School, Duke University, Durham, North Carolina 27706.

Students with graduate standing and currently employed as teachers who wish only to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 4 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application form at the end of this *Bulletin* may be used.

Academic Regulations

Types of Course Enrollment. Summer Session courses may be taken for credit or may be audited. A student's program may be exclusively in one of these categories, or may combine the two of them. Students taking a full or partial program for credit may enroll as auditors in any number of additional courses.

The summer session term *credit* does not mean degree credit at Duke University unless the student has been admitted as a degree candidate by one of the colleges or schools of the University. A student taking a course for credit is expected to do all the work required and to take the final examination, and he will receive a grade. G.I. Bill benefits are available only to those veterans who enroll for credit.

An auditor is entitled to listen to lectures and class discussions, but he may not participate in discussions or take examinations. A student carrying a full program for credit may be given permission to audit as many courses as he desires without additional fees. Students carrying less than a full program for credit may secure permission to audit but are required to pay the auditing fee, which is half the regular fee.

Credits. The summer session courses are of the same quality and credit values as courses in the regular semester. Credit earned in the summer session is in terms of courses or units. The majority of summer session courses carry one course or three graduate units of credit and require one term in residence.

A student desiring either graduate or undergraduate credits transferred from Duke University to his university or college as degree credit must request from the Director of the Summer Session, Duke University, a Course Approval Form to be completed by the student's dean or registrar and returned to the Director of the Summer Session.

Under certain circumstances a maximum credit of 6 units in a master's degree program may be allowed for graduate courses completed elsewhere. Approval for the transfer of credits will not be given until the student has spent one semester or two terms in residence. The acceptance of credit up to this amount will not reduce the minimum period of full-time registered residence at Duke University. In no case will credit be allowed for extension or correspondence courses.

With the approval of both the student's major department and the Dean of the Graduate School, a student who is granted such transfer for credit may be permitted to register for as much as 12 units for thesis research instead of the usual 6 units. Or he may be permitted to fill out his schedule with as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level.

For regulations concerning the application of graduate credit earned elsewhere to a graduate program here, consult the *Bulletin of the Graduate School.*

See page 7 for information concerning reciprocal agreement with the University of North Carolina.

Professional credits toward teacher's certificates are granted by the various state boards of education, each in accordance with its own carefully planned rules. Teachers in service, before enrolling for certification credit, should consult the rules laid down by their State Board of Education. If necessary, they should send to their State Board of Education a list of the courses in which they plan to enroll and inquire whether these will be acceptable for certification credit.

Maximum Course Program. The maximum program for one term of the summer session is two courses.

Grading. Only a student taking a course for credit will receive a grade. The grade given represents the quality of the work done in the course.

Passed. The following are passing grades for undergraduates and graduates:

Undergraduate Grades	Graduate Grades
A—excellent	E—exceptional
B—good	G—good
C—average	S—satisfactory
D—pass	

Failed. A grade of *F* indicates that the student has failed the course, and in order to receive credit for the course he must repeat the work in class.

Incomplete. A grade of *I* may be reported by the instructor if for any reason he is unable to report the final grade at the regular time. Incomplete courses must be completed before the close of the succeeding semester; otherwise the *I* is recorded as *F*, and the course must be repeated in class if the student is to receive credit for it.

Absent from Final Examination. The grade of *X* indicates that the student was absent from the regularly scheduled examination. A student absent from examination, if the absence has been excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, may receive an examination upon the payment of $5 to the Bursar of the University. The instructor concerned arranges for the examination in cases where absences are excused. A student with an *X* grade who has not obtained a passing grade before the end of the semester following that in which the *X* was incurred is regarded as having failed in the course concerned and must repeat the work in class in order to receive credit. If a student's absence from an examination is not excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, his grade for the course concerned is recorded as *F*.

Pass-Fail Option. With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each semester. In addition, with the consent of the instructor, adviser, and director of undergraduate studies a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain internships and small group experiences will be offered only on a pass/fail basis.

A student enrolling in a course on a pass/fail basis completes all the work of the course but receives either a pass (*P*) or fail (*U*) grade in lieu of a standard grade. After the first week of classes in any semester, no student may change his status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

For the effect of the election of the pass/fail option in determining honors, consult the *Bulletin of Undergraduate Instruction.*

Examinations. Final examinations in courses are held on the last two days of each term. Final examinations for short courses will be held on the last day of the course. The examination dates for the first term are June 14-15, second term July 19-20, and third term August 23-24.

Courses in science for the first term have been scheduled so that their final examination will come on June 15. The science courses which begin on June 18 and run for four weeks will have their final examination on July 13. The University has no provision for giving examinations *in absentia.* Students absent from examinations for valid reasons are permitted a liberal extension of time to return to the University for the completion of credit.

Continuation Requirements. A student must achieve a satisfactory record of performance during the Summer Session in order to maintain his enrollment at Duke. He may be dismissed temporarily or permanently by the dean of his college or the Director of the Summer Session for failure to make satisfactory progress.

Dropping of Courses. If a student drops a course without permission from the dean of the school or college in which he is enrolled or, in the case of the special or unclassified student, the Director of the Summer Session, the grade for that course is recorded as *F*. If he drops a course with permission, the grade for that course is *F* unless, in the judgment of the dean or director, circumstances do not justify this penalty.

Withdrawal from the Summer Session. If a student wishes to withdraw from the summer session, he must notify both the dean of the school or college in which he is registered and the Director of the Summer Session.

Motor Vehicle Regulation

Students enrolled in the summer session must register their motor vehicles with the Traffic Office, 2010 Campus Drive, West Campus.

To register a vehicle, the student must present the following documents: (1) state vehicle registration certificate; (2) valid driver's license; and (3) satisfactory evidence of automobile liability insurance as required by North Carolina law—$10,000 per person, $20,000 per accident for personal injuries, and $5,000 property damage. A small parking fee will be charged.

Parking, traffic, and safety regulations will be given each student who registers his vehicle. Students are expected to abide by these regulations.

9

Courses of Instruction

Course Enrollment

Eligibility. Courses numbered 1-49 are primarily for freshmen, or freshmen and sophomores. Courses numbered 50-99 are ordinarily for sophomores, or sophomores and juniors. Courses numbered 100-199 are designed for juniors and seniors. Courses numbered 200-299 are planned for seniors and graduates. Courses numbered 300 up admit graduate students only. Courses numbered from 200 up are limited in enrollment to 25 students.

Minimum Enrollment Required. All courses are offered subject to minimum enrollments. The University reserves the right to withdraw undergraduate courses in which fewer than twelve students enroll, senior-graduate courses numbered 200-299 in which fewer than ten students enroll, and graduate courses and seminars numbered 300 or above in which fewer than six students enroll. In withdrawing a course, the University attempts to avoid undue hardships on students. Sometimes, therefore, courses are offered in spite of small enrollments. Courses not listed will be given when a demand develops and an instructor is available.

Department Officers and Regulations

Departments offering summer session programs are listed alphabetically. Under each department is given the name of the chairman, of the director of graduate studies, and of the director of undergraduate studies. Where departments have set up special regulations for admission to candidacy for the master's degree, these are included.

Summer Session Schedule of Classes

Summer session classes will meet Monday through Friday each week, except classes will be held on Saturday, May 19 and May 26 during Term I; on Saturday, June 23 and June 30 during Term II; and on Saturday, July 28 and August 11 during Term III. The other Saturdays during each term are available for conferences or class work.

Class periods are as follows:

First period-8:00 a.m.-9:20 a.m.
Second period-9:40 a.m.-11:00 a.m.
Third period-11:20-12:40 p.m.
Fourth period-1:20-p.m.-2:40 p.m.

The meeting place for a course is indicated immediately after the class period for the course. Building designations are as follows:

East Campus

A—West Duke
B—Carr
C—Science
F—Bivins

West Campus

3—Gray
4—Perkins Library
5—Foreign Languages
9—Psychology-Sociology
10—Social Sciences
49—Physics
53—Allen
58—Biological Sciences
65—Gross Chemistry
CG—Card Gym

Anatomy

Professor Robertson, *Chairman* (401 Davison, West Campus); Assistant Professor Adelman, *Director of Graduate Studies* (349 Bell Building, West Campus)

First Term

312. Research. Individual investigations in the various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

340. Tutorial in Advanced Anatomy. (Consult *Graduate School Bulletin* for description.) *Staff.*

354. Research Techniques in Anatomy. (Consult *Graduate School Bulletin* for description.) *Staff.*

Second Term

208. Anatomy of the Trunk. Designed for Ph.D. candidates in anatomy as well as practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisites: core course in anatomy and permission of instructor. Number of students arranged by staff. 2 units. *Duke.*

216. Anatomy of the Head and Neck. A study in detail of the general organization of head and neck. Emphasis on individual dissection, clinical implications, and phylogenetic continuities. Prerequisites: Anatomy 301 and permission of instructor. Minimum enrollment, 9; maximum, 20. 2 units. *Shafland and Hylander.*

312. Research. Individual investigations in the various fields of anatomy.

(Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

Third Term

312. Research. Individual investigations in the various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

Anthropology

Associate Professor Fox, *Acting Chairman* (344 Sociology-Psychology Building); Assistant Professor O'Barr, *Director of Graduate Studies* (341 Sociology-Psychology Building); Assistant Professor Casson, *Director of Undergraduate Studies* (263 Sociology-Psychology Building)

Details concerning the program of studies in anthropology may be obtained from the brochure *Graduate Program in Anthropology.*

First Term

94. Cultural Anthropology. A study of the dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. One course. *Lukas.* 9:40-11:00. 9.126

Second Term

93. Human Origins. Origins and distribution of mankind; primate evolution; a survey of human paleontology and human biology, prehistory and language; and the origins of human social organization and culture. One course. *Lukas.* 9:40-11:00. 9.127.

138. The Analysis of Mythology and Ideology. Relationships between social institutions and symbolic orderings as expressed in myths and cosmologies. Case materials and studies from both pre-literate and industrialized societies. One course. *Beaver.* 11:20-12:40. 9.127.

Third Term

130. Cultural Change and Stability. Contemporary theories of culture change, especially those resulting from acculturation and from implementation of programs of technical and economic aid; a consideration of the factors significant in maintaining stability of stimulating change in traditional cultures. One course. *Beaver.* 9:40-11:00. 9.127.

Art

Professor Covi, *Chairman* (211 Art Building, East Campus); Professor Jenkins, *Director of Undergraduate Studies* (203 Art Building, East Campus)

First Term

66. Introduction to Modern Art. Development of architecture, sculpture, and painting in Europe and America from about 1750 to the present. One course. *Markman.* 8:00-9:20. 10.232.

149. Pre-Columbian Art and Archaeology. Architecture, sculpture, pottery, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region of South America before the Spanish conquest. One course. *Markman.* 11:20-12:40. 10.232.

Asian and African Languages

JAPANESE

First Term

161. Modern Japanese Fiction in Translation. Readings of twentieth-century Japanese novels and short stories. One course. *Rolf.* 11:20-12:40. B.107.

Biochemistry

Professor Hill, *Chairman* (255 Medical Sciences I); Professor Kirshner, *Director of Graduate Studies* (243 Medical Sciences I)

First Term (Durham Campus)

208. Laboratory Methods in Biochemistry. An advanced laboratory course that emphasizes current procedures, instrumentation, and experiments. Each student selects from a number of experiments of a wide range of classical investigations that illustrate significant biochemical progress. Hours to be arranged. One course (3 graduate units). *Staff.*

Second Term (Duke Marine Laboratory, Beaufort)

276. Comparative and Evolutionary Biochemistry. (Also Zoology 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. Two courses (6 graduate units). *Sullivan.*

Botany

Professor Wilbur, *Chairman* (147 Biological Sciences); Associate Professor Strain, *Director of Graduate Studies* (136 Biological Sciences); Associate Professor White, *Director of Undergraduate Studies* (371 Biological Sciences)

Students admitted to candidacy for an advanced degree in botany should have completed a minimum of 12 semester hours of courses in botany (or biology) beyond an elementary course, and related work in biological sciences. Students who have not yet had the minimum hours, however, may enter higher courses by permission of the instructor, if he is convinced that they can carry the work for undergraduate credit, and may count such work toward hours necessary for candidacy.

First Term (Durham Campus)

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

First Term (Duke Marine Laboratory, Beaufort)

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

Second Term (Durham Campus)

55. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or permission of instructor. One lab course. *White.* 8:00-12:00. 58.112.

205. Anatomy. Intensive survey of vascular plant cell types, tissues, and organs, with emphasis on the modern application of anatomy to problems of systematics and phylogeny. Laboratories will include microtechnique. Special project and term paper stressing current techniques and literature required. Prerequisite: permission of instructor. 4 units. *White.* 8:00-12:00. 58.112.

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

Second Term (Duke Marine Laboratory, Beaufort)

S205. Introductory Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. Two courses (6 graduate units). *Staff.*

225. Special Problems. Hours to be arranged. *Searles.*

359. Research. Hours to be arranged. *Searles.*

Third Term (Durham Campus)

156. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Prerequisites: introductory biology. One lab course. Laboratory, lectures, and field trips. *Hosier.* 8:00-12:00. 58.112.

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. *Hosier.* 8:00-12:00. 58.112.

226. Special Problems. Hours to be arranged. *Staff.*

360. Research. Hours to be arranged. *Staff.*

Third Term (Duke Marine Laboratory, Beaufort)

211. Marine Phycology. An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. Two courses (6 graduate units). Hours to be arranged. *Searles.*

226. Special Problems. Hours to be arranged. *Staff.*

360. Research. Hours to be arranged. *Staff.*

Chemistry

Professor Quin, *Chairman* (101 Paul M. Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (330 Paul M. Gross Chemical Laboratory); Associate Professor Wells, *Director of Undergraduate Studies* (333 Paul M. Gross Chemical Laboratory)

All classes in chemistry. Term I, will begin on May 21 and continue through June 15. Classes in Term II will begin on June 18 and continue through July 13.

First Term

11. Principles of Chemistry. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes stoichiometry and atomic and molecular structure. Laboratory work includes both qualitative and quantitative analysis. Two hours of class and three hours of laboratory daily. Prerequisites: one year of high school chemistry and qualification for Mathematics 31. One lab course. *Wells.* Laboratory daily, 9:30-12.30; recitation and lecture daily, 1:30-3:30. Lab, 65.211; lecture, 65.103; recitation, 65.111.

61. Physical Chemistry of Aqueous Solutions. An intensive study of chemical equilibria with special attention to the physical chemistry of aqueous solutions, ionic and molecular structure, and elementary thermodynamics. Laboratory experiments illustrate the principles of gravimetric, columetric, and instrumental analysis. Prerequisites: Chemistry 1-2 and Mathematics 31 or equivalent. One lab course. *Wilder.* Lecture and recitation daily, 9:30-11:00; laboratory daily, 12:00-4:30. Lab, 65.242; Lecture 65.104.

151. Organic Chemistry. An introduction to the study of the compounds of carbon in which the chemistry of both aliphatic and aromatic compounds is considered. Laboratory experiments are selected to illustrate the more important reactions, and preparations of organic compounds. Prerequisite: Chemistry 61 or permission of Director of Undergraduate Studies. One lab course. *Ludt.* Lecture daily, 9:30-11:30; laboratory daily, 12:30-3:30. Lab, 65.224; lecture, 65.103.

275. Thesis Research. Research in the fields of physical, analytical, inorganic, or organic chemistry. Open to those students whose research programs for the M.A. and Ph.D. degrees have been approved by the department and by one of the instructors in charge of the course. Schedule to be arranged. (Not more than 1 unit of credit per week for full-time schedule or 1 unit each two weeks for half-time schedule.) 2 to 8 units. Available during Terms I, II, and III.

Second Term

12. Principles of Chemistry. Continuation of Chemistry 11. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Two hours of class and three hours of laboratory daily. Prerequisite: Chemistry 11 or its equivalent. One lab course. *Bonk.* Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Lecture 65, 111; lab, 65.211; recitation, 65.110.

152. Organic Chemistry. A continuation of Chemistry 151. Prerequisite: Chemistry 151. One lab course. *Wolfe.* Lecture daily, 9:30-11:30; laboratory daily, 12:30-3:30. Lecture, 65.103; lab, 65.224.

240. Chemical Oceanography. (Also Zoology 240). See Zoology 240 for course description. Given at Marine Laboratory, Beaufort.

Classical Studies

Professor Oates, *Chairman* (325 Carr Building, East Campus); Assistant Professor Rigsby, *Director of Undergraduate Studies* (204 Carr Building, East Campus)

First Term

54. Roman History. (Also History 54.) The Roman republic and empire to the Council of Nicaea. One course. *Oates.* 9:40-11:00. 5.219.

134. The Athenian Empire. (Also History 125.) Imperial democracy at Athens and its consequences for the *polis*. One course. *Oates.* 11:20-12:40. 5.219.

Second Term

117. Ancient Mythographers. (Also Comparative Literature 117.) Myth in classical and mediaeval writers from Hesiod to Boccaccio. One course. *Newton.* 9:40-11:00. 5.217.

Comparative Literature*

Second Term

117. Ancient Mythographers. (Also Classical Studies 117.) Myth in classical and mediaeval writers from Hesiod to Boccaccio. One course. *Newton.* 9:40-11:00. 5.217.

151. Theory and Form of Tragedy. A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also listed as French 151.) One course. *Fowlie.* 8:00-9:20. 5.014.

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Salinger*

193. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Salinger*

205. Foundations of Twentieth-Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. One course (3 graduate units). *Salinger.* 11:20-12:40. 5.109.

Computer Science

Associate Professor Patrick, *Acting Chairman* (405 Computation Center)

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* For Latin American Literature in Translation, see Spanish 157.

First Term

51. Introduction to Digital Computation. Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. (Also listed as Mathematics 51.) One course. *Patrick.* 1:20-2:40. 49.120.

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential Equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) One course (3 graduate units). *Patrick.* 9:40-11:00. 49.120.

Second Term

150. Computers and Programming. Computer structure, machine language, instruction execution, addressing techniques, and digital representation of data. Computer systems organization, logic design, micro-programming, and interpreters. Symbolic coding and assembly systems, macro definition and generation, and program segmentation and linkage. Prerequisite: Computer Science 51. One course. *Austin.* 9:40-11:00. 49.120.

251. Computer Science for Teachers. An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. One course (3 graduate units). *Austin.* 11:20-12:40. 49.120.

Third Term

152. List Processing and Data Structures. Linear lists such as stacks, queues, deques, circular lists, and doubly linked lists; trees; multilinked structures; dynamic storage allocation. Exercises will require use of an assembly language. Prerequisites: Computer Science 51 and 150. (Also listed as Mathematics 152.) One course. *McAnulty.* 9:40-11:00. 49.120.

163. Data Analysis. Elements of probability and statistics, acquisition of data, maintenance of data bases, computation and display of statistical summaries. Prerequisites: Computer Science 51 and Mathematics 31 or equivalent. One course. *Woodbury.* 11:20-12:40. 49.120.

Economics

Professor Davies, *Chairman* (302 Social Sciences); Associate Professor Weintraub, *Director of Graduate Studies* (204 Social Sciences); Assistant Professor Black, *Director of Undergraduate Studies* (233 Social Sciences)

First Term

52. Competition, Monopoly, and Welfare. Similar to Economics 2, but at a slightly more advanced level. (For sophomores, juniors, and seniors and not open to students who have had Management Sciences 50.) One course. *de Marchi* 8:00-9:20. 10.227.

53. Economics of Contemporary Issues. Topics such as environmental quality and "free" resources, crime, exploitation and discrimination (racial and sexual), the ghetto, wage and price controls, education, athletics, and the welfare-warfare state. Prerequisite: Economics 51 and 52. One course. *Havrilesky.* 9:40-11:00. 10.227.

108. Economics of War. Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament, and the economy. Prerequisite: Economics 52. One course. *Fitzgerald.* 11:20-12:40. 10.227.

115. Fundamentals of Geography. A functional social studies approach to geographic factors and their interrelationships. One course. *Tuthill.* 8:00-9:20. 53.226.

Second Term

51. National Income and Public Policy. Introductory course similar to Economics 1, but at a slightly more advanced level. (For sophomores, juniors, and seniors.) One course. *Vernon.* 8:00-9:20. 10.224.

149. Microeconomic Theory. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. One course. *Graham.* 9:40-11:00. 10.220.

153. Money and Banking. The lender's side of financial markets. The activities of commercial banks and other financial institutions in supplying loanable funds and the effect of these activities on the money supply and its rate of use, the impact of central bank and Treasury operations on financial markets, and the evolution of the present monetary system and its institutions. One course. *Yohe.* 11:20-12:40. 10.220.

214. Geonomics: Geography and Contemporary Economics of Africa. Environmental factors in relationship to major economic activities, emphasizing the resource base, ecological adjustments, landscape morphology, and international interdependence. A series of national studies synthesized into a continental format. Prerequisite: permission of instructor. One course. *Tuthill.* 8:00-9:20. 4.027.

Education

Professor Hurlburt, *Chairman* (213-I West Duke Building, East Campus); Associate Professor Johnson, *Director of Graduate Studies* (213-C West Duke Building, East Campus); Associate Professor Sublett, *Director of Undergraduate Studies* (213-K West Duke Building, East Campus)

Duke University is accredited by the National Council of Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctor's degree as the highest degree approved.

It is the intention of the department to make available to degree candidates all courses ordinarily required for certification as graduate teachers, counselors, principals, and superintendents. These courses will normally be offered at least once every three years.

First Term

113. History of American Education. A study of American education from colonial times to the present. The development of schools—their organizations, administration, curriculum, and methods as seen in relation to the social forces that have produced our particular type of civilization. One course. *Johnson.* 9:40-11:00. 53.225.

Second Term

207. Social History of Twentieth-Century American Education. The development of twentieth-century American education in the context of social and intellectual history. One course (3 graduate units). *Johnson.* 8:00-9:20. 53.225.

211. The Problem Child. (Also Psychology 211.) Study of problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. One course (3 graduate units). *I. Gehman.* 9:40-11:00. 9.129.

223. Teaching the Language Arts. Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. Increasing opportunities for creative expression. Correlation of language arts with other activities and school subjects. One course (3 graduate units). *Adams.* 9:40-11:00. 53.225.

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course (3 graduate units). *Cartwright.* 2:00-3:20. A.204.

226. Teaching Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for developmental and remedial programs. One course (3 graduate units). *Adams.* 11:20-12:40. 53.225.

233. Improvement of Instruction in English. This course will acquaint the student with recent developments in the teaching of English and will introduce him to research techniques in the field. Each student will pursue an extensive independent study based on his particular interests. One course (3 graduate units). *Shuman.* 11:20-12:40. A.202.

234. Secondary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the secondary school staff. The scope of secondary education is considered to encompass junior high school, regular high school, senior high, and junior college. Special treatment is given to the problems of internal organization and management. One course (3 graduate units). *Pittillo.* 9:40-11:00. 53.226.

237. The Teaching of Literature in Secondary Schools. This course surveys the literature generally taught in secondary schools. Both adult and transition-type literature are considered. Methods of organizing the program and of teaching literature are explored. One course (3 graduate units). *Shuman.* 2:00-3:20. A.202.

243. Personality Dynamics. A study of personality structure and dynamics with emphasis upon the implications for counseling and instruction. Prerequisites: 6 units of psychology or educational psychology. One course (3 graduate units). *S. Gehman.* 8:00-9:20. A.202.

246. Teaching of Mathematics. This course deals with such topics as aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. One course (3 graduate units) *Troy*. 2:00-3:20. 49.218.

250, 251, Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and the organization of instructional materials. Work with children under the supervision of a certified teacher of emotionally disturbed children. Experience in general classroom teaching and small group and individualized instruction. Participation in staff conferences involving psychiatrists, psychologists, social case workers, and professional educators. One course (3 graduate units) each. *S. Gehman*. Hours to be arranged.

276. The Teaching of High-School Science. Discussion, lectures, and collateral reading, related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary school science. One course (3 graduate units). *Githens*. 2:00-4:00, Monday through Friday. A.103.

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216.
315.1 3 graduate units. *Carbone*. 12:15-1:35. Rogers-Herr.
315.2 3 graduate units. *Carbone*. 8:00-9:20. Rogers-Herr.

323. Public School Finance. A study of educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 graduate units. *Pittillo*. 11:20-12:40. 53.226.

332. Supervision of Instruction. A study of the nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. July 2-20. 3 graduate units. *Hurlburt*. 8:00-9:20 and 1:00-2:00. A.204.

Third Term

201. Teaching and Supervision of Arithmetic. This course gives special attention to the number system, the fundamental operations (with whole numbers, fractions, and decimals), percentage, and measurements. Consideration given to meaning theory, method of teaching, problem-solving, evaluation, practice and drill, and selection and gradation of arithmetical contents. Designed for teachers and supervisors in the elementary school. One course (3 graduate units). July 23-August 10. *Petty*. 11:20-12:40 and 2:00-3:20. 53.225.

213. Elementary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the elementary school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment is given to the problems of internal organization and management of the elementary school, and its integration with the secondary school level. One course (3 graduate units). *Sublett*. 11:20-12:40. 4.346.

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. One course (3 graduate units). *Davis.* 9:40-11:00. A.204.

222. New Developments in Elementary School Curriculum. Curriculum and materials of the modern elementary school. Special attention is given to innovations such as the open classroom, team teaching, non-graded programs, and individualized instruction. Recent emphasis on early childhood education and the middle school is assessed. One course (3 graduate units). *Sublett.* 9:40-11:00. 4.346.

249. Exceptional Children. A survey of the major categories of exceptional children—mental retardation, emotional disturbance, brain injured, learning disabilities, physically handicapped, visual and auditory deficits, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment will be discussed. One course (3 graduate units). *Davis.* 11:20-12:40. A.204.

253. Law and Education. This course examines elements and problems of educational organizations which have come within the purview of constitutional and legislative provisions and court decisions. Emphasis is placed on conflict among members of educational organizations and between educational organizations and other parties which has resulted in appellate court decisions. Students are expected to select appropriate problems for intensive study. One course (3 graduate units). *Martin.* 8:00-9:20. 4.027.

256. Classroom Assessment of Student Achievement. A study of the techniques to be used by classroom teachers in the evaluation of student progress. Special emphasis will be directed to teacher-made tests. One course (3 graduate units). *Colver.* 11:20-12:40. A.202.

260. Introduction to Educational Research. Research methodologies: experimental, historical, survey, philosophic, and case study. Fundamentals of statistical inference, research design, and computer applications to research problems. One course (3 graduate units). *Katzenmeyer.* 8:00-9:20. A.202.

285. Audio-Visual Aids in Education. The aims and psychological bases of audio-visual materials in the classroom. Attention to such materials as charts, filmstrips, flat pictures, maps, models, motion pictures, radio, records, slides, and television. One course (3 graduate units). *Letro.* 1:20-2:40. A.202.

360. Seminar on Instructional Strategies. This seminar will present various theoretical and analytical models for comprehending teacher instructional strategies and teacher-student interaction in regard to their influence on the learning process. Students will review relevant research, analyze tapescripts and videotapes of classroom performance, and pursue applications of the models in a variety of settings. 3 graduate units. *Katzenmeyer.* 9:40-11:00. A.202.

Engineering

Professor Pearsall, *Dean of the School of Engineering* (136 Engineering Building); Professor Meier, *Assistant Dean* (136 Engineering Building); Assistant Professor George, *Assistant Dean* (136 Engineering Building.)

First Term

B.M.E. 265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering, tailored to fit the requirements of a small group. Prerequisite: approval of the chairman and the instructor under whom work will be done. 1 to 4 units. *Staff.*

B.M.E. 399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff.*

C.E. 197-198. Projects in Civil Engineering. These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisite: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. *Staff.*

C.E. 365. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. *Graduate Staff.*

C.E. 399. Special Readings in Civil Engineering. Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff.*

E.E. 265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisite: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. *Graduate Staff.*

E.E. 399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff.*

M.E. 197-198. Projects in Mechanical Engineering. This course may be assigned by the Chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisite: 3.0 average and senior standing. One-quarter to two courses. *Staff.*

M.E. 265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within the Mechanical Engineering Department tailored to fit the requirements of a small group. Prerequisite: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. *Graduate Staff.*

M.E. 300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. *Graduate Staff.*

M.E. 399. Special Readings in Mechanical Engineering. Special individual readings in a specified area of study in mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff.*

English

Professor Ferguson, *Chairman* (325 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professor Williams, *Director of Undergraduate Studies* (402 Allen Building.)

Candidates for the master's degree in English are expected to have had at least 18 units in undergraduate courses above the sophomore level. The department may also require additional courses if the work of the student in his first term indicates inadequate preparation.

First Term

21S. Studies in the Novel. A study of major themes and forms of the novel. At least one novel from early periods will be investigated, but the course will concentrate on nineteenth and twentieth-century works. One course. *Ferguson.* 11:20-12:40. 4.230.

55. Representative British Writers. Chaucer's Prologue to *The Canterbury Tales,* and at least two tales, Shakespeare's *I Henry IV, Hamlet,* or *King Lear,* and one other play, John Donne's poetry (selections), and Milton's *Paradise Lost* (selections) and some of the shorter poems. One course. *Ferguson.* 9:40-11:00. 53.326.

124. Shakespeare. The tragedies and later comedies. One course. *DeNeef.* 8:00-9:20. 53.326.

175. American Literature from 1860 to 1915. Dickinson, Twain, James, the social and philosophical essayists, Crane, Dreiser, Robinson, and Frost. One course. *Anderson.* 9:40-11:00. 53.327.

184S. Special Topics: American Dialect Literature. An examination of the uses of dialect in the works of representative American writers (e.g., Joel Chandler Harris, Stephen Crane, Eudora Welty, Eugene O'Neill). Texts may be considered either as source material for dialect study or as literature for which the author's use of dialect is an important literary device. One course. *Butters.* 11:20-12:40. 53.328.

264. American Literature, 1800-1865. The writers emphasized are Poe and Melville. One course (3 graduate units). *Anderson.* 11:20-12:40. 53.327.

Second Term

56. Representative British Writers. Novels by Fielding (*Joseph Andrews*), Dickens (*Great Expectations*), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. *Monsman.* 9:40-11:00. 53.327.

158. The English Novel in the Twentieth Century. Some of the writers studied are Conrad, Lawrence, Forster, Joyce, Woolf, Huxley, Cary, Amis, and Golding. One course. *Mellown.* 9:40-11:00. 53.326.

176. American Literature since 1915. Poetry, fiction, drama, and critical prose from Stein, Anderson, O'Neill, Hemingway, and Faulkner to such contemporary authors as Malamud and R. Lowell. One course. *Clum.* 8:00-9:20. 53.326.

182S. Metaphysical Poetry. Studies in Donne, Herbert, Crashaw. (Any conference course number may be taken twice.) One course. *Williams.* 11:20-12:40. 53.328.

224. Shakespeare. The plays. One course (3 graduate units). *Williams.* 9:40-11:00. 53.318.

246. English Literature of the Later Nineteenth Century. The writers emphasized are Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. One course (3 graduate units). *Monsman.* 8:00-9:20. 53.327.

376. Studies in Twentieth-Century American Literature. Selected problems posed by the poetry, prose, fiction, or drama of this century. 3 graduate units. *Duffey.* 11:20-12:40. 10.225.

Third Term

159. Modern British Drama. English and Irish drama from the late nineteenth century to the present. One course. *Reardon.* 9:40-11:00. 53.326.

182S. Conference on Poetry. Intensive studies in selected poems of Yeats and Eliot, with attention to critical theory and emphasis on form and style. (Any conference course number may be taken twice.) One course. *Smith.* 11:20-12:40. 53.328.

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course (3 graduate units). *Nygard.* 1:20-2:40. 53.318.

252. English Literature of the Twentieth Century. The writers emphasized are Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. One course (3 graduate units). *Smith.* 9:40-11:00. 53.318.

267. American Literature, 1865-1920. Selected works of representative authors of the period: Whitman, Lanier, Mark Twain, James, Howells, Emily Dickinson, Henry Adams, and the Local Colorists. One course (3 graduate units). *Budd.* 8:00-9:20. 53.326.

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course (3 graduate units). *Nygard.* 9:40-11:00. 53.327.

364. Hawthorne and Melville. Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 graduate units. *Jones.* 11:20-12:40. 53.326.

Forestry

Professor Ralston, *Dean of the School of Forestry* (213 Biological Sciences Building, West Campus); Professor Anderson, *Director of Graduate Studies* (04 Biological Sciences Building, West Campus)

Qualified students may engage in thesis research in certain branches of forestry during the summer session with the approval of the instructor concerned and the Dean of the School of Forestry, or of the Director of Graduate Studies in the case of work taken through the Graduate School.

357. Research in Forestry. Open to students whose research programs for the M.F. or D.F. degree have been approved by the Dean of the School of Forestry and the instructor responsible for directing the research and whose programs for the A.M., M.S., or Ph.D. degree have been approved by the Director of Graduate Studies and the instructor in charge. (Credits and schedule to be arranged.)

May 14-August 24, 2 to 12 units. (Not more than 1 unit of credit per week for full-time schedule or 1 unit each two weeks for half-time schedule.) Consult courses 301-302 in the *Bulletin of the School of Forestry* for the letter designation of branches of forestry in which research is to be conducted. *Staff*

Geology

Professor Heron, *Chairman* (118 Science Building, East Campus); Associate Professor Perkins, *Director of Graduate Studies* (111 Science Building, East Campus); Associate Professor Furbish, *Director of Undergraduate Studies* (104 Science Building, East Campus)

The class in Geology 1, Term I, will begin on May 21 and continue through June 15. The class in Geology 2, Term II, will begin on June 18 and continue through July 13. Students who wish to avoid paying a late registration fee must have their registration completed in advance of these dates. For registration dates see General Registration on page 29 of this *Bulletin*.

First Term (Durham Campus)

1. Geological Environments and Man. Physical and chemical environments acting on the earth with special emphasis on their interaction with man. One lab course. *Heron*. Lectures or recitations, 8:00-10:30, Monday through Friday; laboratory, 1:00-3:00, Monday through Thursday. May 21-June 15. Lectures and recitations, C.116; lab, C.024.

Second Term (Durham Campus)

2. History of the Earth. Including the physical development and the geological evolution of life. One lab course. *Lynts*. Lectures or recitations, 8:00-10:30, Monday through Friday; laboratory, 1:00-3:00, Monday through Thursday. June 18-July 13. Lectures and recitations, C.116; lab, C.024.

Second Term (Duke Marine Laboratory, Beaufort)

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distributions, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (This course is not open to students who have completed Geology 206.) Two courses (6 graduate units). *Pilkey*

German

Professor Phelps, *Chairman and Director of Graduate Studies* (102 Language Building); Assistant Professor Novak, *Director of Undergraduate Studies* (111 Language Building)

The work in German 1, 2 and 63 will be coordinated with listening and oral practice in the language laboratory which students in German classes will be privileged to attend.

First Term

1. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One lab course. *Bessent.* 11:20-12:40 and Tuesdays and Fridays 2:00-3:20. 5.109.

63. Intermediate German. Grammar review and composition; reading of short stories, novels, and poems. Prerequisite: German 1-2, or two units of high school German. One lab course. *Stern.* 9:40-11:00 and Mondays and Thursdays, 2:00-3:20. 5.109.

172. Modern German Literature in English Translation. Representative works by such writers as Mann, Kafka, Hesse, Brecht, Böll, and Grass. One course. *Novak.* 11:20-12:40. 5.211.

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Staff.* Hours to be arranged.

193. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Staff.* Hours to be arranged.

Study Abroad Program. Six-week program (May 20-July 6, 1973). In Munster, Germany. Two course credit allowed. Director: Mr. Günter Klabes. For complete details, contact Mr. Klabes or Chairman of German Department.

Second Term

2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Prerequisite: German 1 or equivalent. One lab course. *Bessent.* 11:20-12:40 and Tuesdays and Fridays, 2:00-3:20. 5.109.

91. Introduction to German Literature. Readings from representative German authors. One course. *Alt.* 11:20-12:40. 5.211.

117. German Conversation. A course primarily in speaking German with some practice in writing. One course. *Alt.* 8:00-9:20. 5.109.

192. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Staff.* Hours to be arranged.

194. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Staff.* Hours to be arranged.

Graduate Reading Course. An intensive course in German to develop rapidly the ability to read technical German in several fields. For graduate students only. No degree credit. *Alt.* 9:40-11:00. 5.109.

Health and Physical Education (Men) *

Professor Friedrich, *Chairman Health and Physical Education* (105 Card Gymnasium); Associate Professor Skinner, *Director of Undergraduate Studies* (106 Card Gymnasium)

* Courses are open to men or women. A course may not be taken for one quarter course credit by a student who has not fulfilled the physical education requirement.

First Term

20. Beginning Swimming. Basic fundamentals of swimming are taught. Quarter-course. *Persons.* 8:00-9:00. Gym.

121. Intermediate Swimming. Beginning and advanced skills along with basic water safety will be stressed in this course. Quarter-course. *Persons.* 11:20-12:40. Gym.

125. Swimming and Life Saving. In this course students may complete requirements to obtain Red Cross Life Saving Certificate. One-fourth course. *Persons.* 9:40-11:00. Gym.

130. Golf. Basic fundamentals and shots in golf are taught. Quarter-course. *Hagler.* 9:40-11:00.

140. Tennis. Primary emphasis is on tennis fundamentals and game strategy. Quarter-course. *LeBar.* 1:20-2:40.

172. The Administration of Health and Physical Education in Secondary Schools. Presents the everyday problems that arise in the experience of the teacher of health and physical education. Open to juniors and seniors. One course. *Friedrich.* 11:20-12:40. Gym.

Health and Physical Education (Women)

Professor Bookhout, *Chairman* (101 Gym, East Campus); Professor Lewis, *Director of Undergraduate Studies* (103 Gym, East Campus)

First Term

1. Modern Dance. May be taken to fulfill physical education requirement (P.E. 1). May be taken for elective credit by students who have fulfilled physical education requirement (P.E. 61, 161). Open to men and women. Quarter-course. *White.* Monday through Thursday. 4:00-5:00. Gym, East Campus.

History

Professor Colton, *Chairman* (235 Allen Building); Professor Young, *Director of Graduate Studies* (237 Allen Building); Professor Hollyday, *Director of Undergraduate Studies* (227 Allen Building)

First Term

51. A History of European Civilization. From the Italian Renaissance to about 1815. One course. *Mulligan.* 8:00-9:20. 53.225.

54. Roman History. (Also listed as Classical Studies 54). The Roman republic and empire to the Council of Nicaea. One course. *Oates.* 9:40-11:00. 5.219.

91. The Development of American Democracy to 1865. A study of the trends vital to an understanding of the United States today. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered in relation to the main theme, the development of American democracy. One course. *Gavins.* 9:40-11:00. 53.226.

125. The Athenian Empire. (Also listed as Classical Studies 134). Imperial democracy at Athens and its consequences for the *polis*. One course. *Oates*. 11:20-12:40. 5.219.

144. History of Modern Japan. Japan from 1867 to the present; the transition from the traditional to the modern state. One course. *Silberman*. 9:40-11:00. 53.229.

145. Afro-American History to 1865. The Black experience in the United States from slavery to the end of the Civil War. One course. *Gavins*. 11:20-12:40. 53.233.

282. Political and Social Change in the United States, 1789-1860. Reforms and the antebellum social order. One course (3 graduate units). *Nathans*. 9:40-11:00. 53.234.

Second Term

52. A History of European Civilization. From about 1815 to the present. One course. *Lerner*. 8:00-9:20. 53.233.

92. The Development of American Democracy, 1865 to the Present. A continuation of History 91 with emphasis upon the emergence of contemporary problems. One course. *Durden*. 9:40-11:00. 53.229.

113. The United States in the Twentieth Century. Political, economic, and social problems of twentieth-century United States. Emphasis will be on the years from 1900 to the 1930's. One course. *Goodwyn*. 8:00-9:20. 53.226.

142. History of China. Emphasis on modern transformations since the nineteenth century. One course. *Dirlik*. 11:20-12:40. 53.233.

219. Historical and Contemporary African Society. One course (3 graduate units). *Azevedo*. Open only to students enrolled in the African Curriculum Development Project. 9:40-11:00. 4.027.

239. History of Socialism and Communism. Origins and development of socialist and communist movements. One course (3 graduate units). *Lerner*. 9:40-11:00. 53.233.

278. The Era of the Civil War and Its Aftermath. Emphasis will be on politics and protest from 1865 to 1900. One course (3 graduate units). *Durden*. 11:20-12:40. 53.229.

295. Recent Interpretations of Ancient and Medieval History. One course (3 graduate units). *Young*. 1:20-2:40. 53.226.

Third Term

131. Mexico and the Caribbean from the Wars of Independence to the Present. One course. *TePaske*. 8:00-9:20. 53.225.

229. Recent Interpretations of Modern European History. Analysis and discussion of key historical problems in European history from the Renaissance to the present. One course (3 graduate units). *Colton*. 2:00-3:20. 53.229.

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and musical and artistic traditions. One course

(3 graduate units). *Hartwig.* Open only to students enrolled in the African Curriculum Development Project. 8:00-9:20. B.107.

252. Recent European History. Political, economic, and intellectual developments in Europe. Emphasis will be on the years since 1929. One course (3 graduate units). *Colton.* 11:20-12:40. 53.226.

255s. Problems in African History. One course (3 graduate units). *Hartwig.* Open only to students enrolled in the African Curriculum Development Project. 9:40-11:00. B.107.

266. Modern South America. Political, social, and economic history of the leading South American nations in the twentieth century. One course (3 graduate units). *TePaske.* 9:40-11:00. 53.225.

Management Sciences

Professor Volpp, *Chairman* (115 Social Sciences Building); Assistant Professor Kuhn, *Director of Undergraduate Studies* (202 Social Sciences Building)

First Term

100. Introduction to Financial Accounting. Conceptual framework of external financial reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economics terms and the interpretation of published financial statements. Prerequisite: sophomore standing. One course. *Hagerman.* 8:00-9:20. 10.231.

120. Organization Theory. Introduction to recent theories of and research on the structure and behavior of complex organizations, with special reference to business firms. Topics to be covered include: rationality, authority, bureaucracy, and other concepts; power, decision-making, informal organization, organization change, and other internal process phenomena; effects of technology, culture, and other environmental influences, brief consideration of organization design. Prerequisite: Management Sciences 50 and 60. One course. *Kuhn.* 11:20-12:40. 10.229.

Second Term

110. Statistics for Management Decisions. Fundamentals of classical and Bayesian statistical analysis and elementary decision theory. Application of statistical analysis to decision problems. Topics include a review of sampling distributions, point and interval estimation, hypothesis testing, decision theory, and regression and correlation analysis (including computer routines). Not open to students who have had Management Sciences 60, Economics 138, or Mathematics 136. Prerequisites: Management Sciences 55 or Mathematics 135, or Economics 54. One course. *Staff.* 9:40-11:00. 10.231.

140. Operations Research. Introduction to the use of mathematical models in the analysis of decision problems. Topics include mathematical programming, game theory, dynamic programming, queuing theory, simulation, and inventory models. Use of electronic computer will be included. Prerequisites: Management Sciences 50, 55, or equivalent, and computer programming competence. One course. *Staff.* 11:20-12:40. 10.231.

Third Term

130. Information Systems. An analysis of the data needed for economic decisions relating to business enterprises and of the systems used in accumulating, analyzing, interpreting, and presenting the data to various users. Financial reporting to external users and managerial use of information for decision-making are stressed. Prerequisites: Management Sciences 50, 55 or equivalent. One course. *Staff.* 9:40-11:00. 10.231.

Mathematics

Professor Shoenfield, *Chairman* (135-Physics Building); Associate Professor Burdick, *Director of Graduate Studies* (135-D Physics Building); Associate Professor Hodel, *Director of Undergraduate Studies* (135-D Physics Building)

First Term

31. Introductory Mathematical Analysis. Language of logic and sets, continuity, differentiation, integration, the fundamental theorem of the calculus. Prerequisite: three units of college preparatory mathematics. One course. *D. Smith.* 11:20-12:40. 49.120.

53. Basic Statistics. Principal statistical methods including application to psychological, economic, business administration, and educational problems. Techniques of data collection and presentation, hypothesis testing, using the chi-square, t, and F distributions, interval estimation and linear regression. Not open to students who have had Economics 138 or Psychology 117. One course. *Wilkinson.* 9:40-11:00. 49.132.

73. Linear Algebra and Intermediate Mathematical Analysis. Vector spaces, linear transformations and matrix representations, determinants, partial differentiation. One course. *Moore.* 11:20-12:40. 49.128.

Second Term

32. Introductory Mathematical Analysis. Elementary and transcendental functions, sequences, series, Taylor's formula. Prerequisite: Mathematics 31. One course. *Burdick.* 11:20-12:40. 49.124

216. Intermediate Analysis. Series; uniform convergence, integration. Theory of functions of a real variable. One course (3 graduate units). *Warner.* 8:00-9:20. 49.124

220. Advanced Linear Algebra with Applications. Solutions of systems of linear inequalities; applications to linear programming and game theory; computation of eigenvalues and eigenvectors. One course (3 graduate units). *MacKichan.* 9:40-11:00. 49.124.

Third Term

226. Theory of Numbers. Divisibility; congruences; Chinese Remainder Theorem; arithmetic functions. One course (3 graduate units). *Henson.* 9:40-11:00. 49.128.

271. Introductory Topology. Set theory, metric spaces, topological spaces; separation axioms; connectedness; continuity; paracompactness. One course (3 graduate units). *Hodel.* 11:20-12:40. 49.128.

Microbiology

Second Term

325. Medical Mycology. A lecture and laboratory course with emphasis on those fungi which cause disease in man and animals. The course includes practical laboratory work with materials from patients in Duke Hospital and those sent to the Duke Fungus Registry from outside sources. July 2-28, 1973. Lecture daily, Monday-Saturday, 8:00-9:00 a.m.; laboratory, Monday-Friday, 9:00-12:00 and 1:30-4:30 p.m., Saturday 9:00-12:00. 4 units. *Conant*

Music

Professor Mueller, *Chairman* (110 Asbury Building, East Campus); Professor Hanks, *Director of Undergraduate Studies* (Asbury Building, East Campus)

First Term

125. Masterworks of Music Literature. An intensive study of selected masterworks which represent the principal currents in modern music history. Compositions by Bach, Mozart, Beethoven, Brahms, Debussy, and Bartok will constitute a frame of reference for historical, biographical, and stylistic analysis. One course. *Mueller*. 8:00-9:20. Bivins 209.

Applied Music Courses. Applied music courses in piano, organ, and voice may be arranged. One half or one course. *Staff*. (Available during all three terms of the summer session).

Second Term

181, 182. Independent Study in Musical Performance. Intensive coaching and performance in chamber music at Kneisel Hall, Blue Hill, Maine. See Music Department for dates and fees. Two courses. *Ciompi and Mueller*

Nursing

Professor Wilson, *Dean* (113 Hanes House, West Campus)

First Term

191, 192, 193, or 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/Fail option. *Staff*.

Second Term

191, 192, 193, or 194. Independent Study. (See description given in Term I.) *Staff*.

Third Term

173. The Child with Diabetes: A Living-Learning Experience. This practicum offers opportunity to care for ambulatory children with diabetes mellitus in a residential summer camp setting. The focus is on principles of diet, medication, and activity modification in management of labile juvenile diabetes and on facilitating self-care by the child with a chronic disease. Open to rising seniors in the nursing major. One course. Pass/Fail option. *Staff.*

177. Administrative Concepts Applied to the Team Leadership Role. Designed to assist the student to use concepts of administration in the team leadership role within a hospital nursing service. Two courses. Pass/Fail option. Open to rising seniors in the nursing major. *Fortune.*

191, 192, 193, or 194. Independent Study. (See description given in Term I.) *Staff.*

Pathology

Professor Kinney, *Chairman* (M301, Davison); Professor Sommer, *Director of Graduate Studies* (301 Davison)

First Term

M357. Research. Hours to be arranged. *Staff*

M361. Advanced General Pathology. See *Bulletin of the Graduate School* for description. 6 units. *Staff*

Second Term

M357. Research.

M362. Second part of M361. Advanced General Pathology.

Third Term

M357. Research. Hours to be arranged. *Staff*

Philosophy

Professor Welsh, *Chairman* (201-K West Duke Building, East Campus); Associate Professor Sanford, *Acting Director of Graduate Studies* (201-J West Duke Building, East Campus); Assistant Professor Aquila, *Director of Undergraduate Studies* (201-G West Duke Building, East Campus)

First Term

48. Logic. A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Coder.* 9:40-11:00. 9.129.

94. History of Modern Philosophy. Bacon, Hobbes, Decartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant. Freshman prerequisite: previous philosophy course and permission of the instructor. One course. *Aquila.* 11:20-12:40. 9.129.

Second Term

106. Philosophy of Law. Natural law theory; legal positivism; legal realism; the relation of law and morality. One course. *Benditt.* 9:40-11:00. 9.133.

112. Philosophy of Mind. Such topics as mind and body, thought, perception, persons, and personal identity. One course. *Welsh.* 11:20-12:40. 9.133.

Physics

Professor Fairbank, *Chairman* (119 Physics Building); Associate Professor Evans, *Director of Graduate Studies* (213 Physics Building); Assistant Professor Rose, *Director of Undergraduate Studies* (242 Physics Building)

Classes in Physics 51, Term I, will begin on May 21 and continue through June 15. Classes in Physics 52, Term II, will begin June 18 and continue through July 13. Students who wish to avoid paying a late registration fee must have their registration completed in advance of these dates. For registration dates see General Registration on page 29 of this *Bulletin.*

First Term

51. General Physics. This course treats the basic principles of general physics in a more quantitative manner than Physics 1-2. It meets in a thorough way the physics requirement for entrance into the study of either medicine or engineering, and is well suited for the general science student. This course is not open for credit for students who have completed Physics 1-2. Prerequisites: Mathematics 31, 32, or equivalent. One lab course. *Evans.* 9:30-4:00. 49.114.

353X. Thesis Seminar. Students who are properly qualified may carry on research work under direction. Credits and hours to be arranged. *Staff.*

Second Term

52. General Physics. A continuation of Physics 51. Prerequisite: Physics 51. One lab course. *Evans.* 9:30-4:00. 49.114.

161. Modern Physics. Relativity, quantum phenomena, atomic and molecular structure and spectra, solids, statistical physics, nuclear physics, elementary particles. Prerequisites: Physics 41-42 and Mathematics 32. One course. *Han.* 9:40-11:00. June 18-July 20. 49.216.

353X. Thesis Seminar. Students who are properly qualified may carry on research work under direction. Credits and hours to be arranged. *Staff.*

Physiology

Professor Tosteson, *Chairman* (388 Medical Sciences I); Associate Professor McManus, *Director of Graduate Studies* (354 Medical Sciences I)

Third Term (Duke Marine Laboratory, Beaufort)

212L. Marine Membrane Physiology. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiological processes. The course includes lectures and laboratory work on the mechanisms and comparative aspects of ionic and osmotic regulation in marine plants and animals. Prerequisite: Permission of instructor. (Also listed as Zoology 212L.) Given at Beaufort. Two courses (6 graduate units). *Gutknecht, Schoffeniels, Wachtel, and Staff.*

Political Science

Professor Barber, *Chairman* (214 Perkins Library); Associate Professor Fish, *Director of Graduate Studies* (308 Perkins Library); Assistant Professor Spragens, *Director of Undergraduate Studies* (313 Perkins Library)

First Term

141. Public Administration. An introduction to the role of administration in the governmental process considering principles of administrative organization, methods of administrative control, personnel, and fiscal management. In general the study of the organizational and administrative problems encountered by any government agency charged with carrying out a public policy. One course. *Hall.* 8:00-9:20. 4.301.

246. Administration and Public Policy. The role of the administrative official as a policy-maker in modern American politics. One course. *Hall.* 11:20-12:40. 4.301.

Second Term

210. Politics and Education. An examination of the various governmental impacts on educational decision-making. One course (3 graduate units). *Leach.* 8:00-9:20. 4.301.

291. Problems of Urban Government. Analysis of problems in the structure and functions of urban governments in the United States. One course (3 graduate units). *Leach.* 9:40-11:00. 4.301.

Third Term

132. Contemporary Political Ideologies. Communism, fascism, democracy, and other significant ideologies. One course. *Spragens.* 8:00-9:20. 4.301.

280. Comparative Government and Politics: Sub-Saharan Africa. Particular attention will be given to traditionalism and modernization, ideologies, leadership, party systems, the adaption of parliamentary institutions, Africanization of the civil services, and the problem of political integration. One course (3 graduate units). *Johns.* 11:20-12:40. 4.301.

Psychology

Professor Jones, *Chairman* (226 Sociology-Psychology); Associate Professor Staddon, *Director of Graduate Studies* (242 Sociology-Psychology); Associate Professor Wing, *Director of Undergraduate Studies* (316 Sociology-Psychology)

Details concerning the program of studies in psychology may be obtained from the brochure *Graduate Studies in Psychology.*

First Term

93. Biological Basis of Behavior. Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Erickson.* 8:00-9:20. 9.126.

94. Personality. Representative theories of personality from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. Not open to students who have had Psychology 116. One course. *Kremen.* 9:40-11:00. 9.127.

101. Social Psychology. Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisites: one course in psychology at the 90-level or permission of the instructor. One course. *McGillis.* 11:20-12:40. 9.127.

Second Term

92. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherrington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. *Guttman.* 11:20-12:40. 9.126.

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 94 or 95. One course. *Carson.* 9:40-11:00. 9.319.

211. The Problem Child. (Also Education 211.) Study of problem behavior and adjustment in children, with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. One course (3 graduate units). *I. Gehman.* 9:40-11:00. 9.129.

253. Personality Development. A survey of behaviors and concepts relating to personality functioning with special emphasis on infancy, childhood, and adolescence. One course (3 graduate units). *Gorman.* 8:00-9:20. 9.129.

Third Term

95. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence; special emphasis on personality and cognitive development. One course. *Kramer.* 11:20-12:40. 9.127.

Religion

Professor Poteat, *Chairman* (117-B Gray Building); Professor Young, *Director of Graduate Studies* (209-A Divinity Building); Associate Professor Kort, *Director of Undergraduate Studies* (218 Gray Building)

First Term

59. Problems in Theology and Ethics. Philosophical, theological, and cultural problems, such as the existence of God, ethical theory, religious language, and the relation of religion to culture. One course. *Clark.* 9:40-11:00. 3.228.

129. The Frontiers of Contemporary Christian Thought. Radical and prophetic movements as represented by Dietrich Bonhoeffer, Henry Cox, Leslie Dewart, Jurgen Moltmann, and others. One course. *Osborn.* 1:20-2:40. 3.228.

140. Religions of India. Major religious traditions of the sub-continent.

Hinduism, Buddhism, Jainism, and Islam. One course. *Lawrence.* 11:20-12:40. 3.228.

170. Problems of Religious Thought. Analysis of credentials for belief in God. One course. *Poteat.* 8:00-9:20. 3.319.

Second Term

50. The Old Testament. Historical, literary, and theological investigations. One course. *Wintermute.* 9:40-11:00. 3.228.

57. Introduction to the History of Religions. Historico-religious study of primitive religions—Hinduism, Buddhism, Islam, and other religions. One course. *Partin.* 8:00-9:20. 3.228.

151. Ethical Issues in Social Change and Public Policy in America. An examination, based on work in Christian ethics and current sociological theory. One course. *McCollough.* 11:20-12:40. 3.228.

188. Recent Literature and its Religious Implications. Religious elements in recent literature. One course. *Kort.* 9:40-11:00. 3.220.

Third Term

124. Christianity in America. Representative men, movements, and thought in American Christianity. One course. *Jones.* 9:40-11:00. 3.228.

141. Religions of China and Japan. Confucianism, Taoism, Buddhism, Shinto, and other religious traditions of China and Japan. One course. *Corless.* 11:20-12:40. 3.228.

Romance Languages

Professor Fein, *Chairman* (205A Language Building); Associate Professor Vincent, *Director of Graduate Studies* (214 Language Building)

FRENCH

First Term

97. Conversational French. Intensive instruction in oral and written expression. Contemporary French prose provides the basis for vocabulary building and for practice in structural patterns. Prerequisite: French 64 or proficiency. One course. *Steegar.* 11:20-12:40. 5.208.

110. French Comedy in the Seventeenth and Eighteenth Centuries. The theatrical tradition of comedy and its evolution; readings from Corneille, Moliere, Lesage, Marivaux, and Beaumarchais. Graduate credit can be arranged. One course. *Stewart.* 9:40-11:00. 5.208.

181. French. An intensive introduction to the language including modern readings. One course. *Hull.* 9:40-11:00. 5.217.

Graduate Reading Course. An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit. One course. *Staff.* 4:00-5:20. 5.208.

Second Term

115. From Romanticism to Naturalism. Readings in Balzac, Stendhal, Flaubert, and Zola. Graduate credit can be arranged. One course. *Niess.* 1:20-2:40. 5.208.

151. Theory and Form of Tragedy. A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also Comparative Literature 151.) Graduate credit can be arranged. One course. *Fowlie.* 8:00-9:20. 5.014.

182. French. An intensive introduction to the language including modern readings. One course. *Staff.* 9:40-11:00. 5.208.

SPANISH

First Term

155. Spanish American Short Fiction. Novellettes and short stories of the twentieth century. Graduate credit can be arranged. One course. *Fein.* 8:00-9:20. 5.211.

157. Latin American Literature in Translation. Fictional and poetic works of the last thirty years that have made an impact on world literature. One course. *Fein.* 9:40-11:00. 5.211.

181. Spanish. An intensive introduction to the language including modern readings. One course. *Murray.* 11:20-12:40. 5.217.

Second Term

97. Spoken Spanish. Intensive instruction in the spoken language: contemporary Spanish prose provides the basis for vocabulary buildings and for practice in structural patterns. Prerequisite: Spanish 64 or equivalent. One course. *Landeira.* 9:40-11:00. 5.208.

182. Spanish. An intensive introduction to the language including modern readings. One course. *Landeira.* 11:20-12:40. 5.208.

Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology); Associate Professor Wilson, *Director of Graduate Studies* (271 Sociology-Psychology); Assistant Professor Hartford, *Director of Undergraduate Studies in Sociology* (276A Sociology-Psychology)

First Term

91. Introduction to Sociology: Concepts and Procedures. Concepts and procedures of sociology and illustrations of their use in understanding specific areas of social life. Open to freshmen. One course. *Simpson.* 9:40-11:00. 9.133.

150. The Family. Analysis of the American family as an institutionalized group and its relationship with other institutions and structural features such as social class and ethnic group. Special attention is devoted to methods of research in this area. One course. *Simpson.* 8:00-9:20. 9.133.

Second Term

143. Deviant Social Behavior. Analysis of deviant behavioral systems (illness, crime, delinquency) in terms of precipitating social factors, patterns and goals, remedial and counteracting controls. One course. *Fraser.* 11:20-12:40. 9.129.

144. Political Sociology. Politics as social behavior involving change in institutions and structures; current national and local issues. One course. *Vogel.* 8:00-9:20. 9.127.

Third Term

142. The Sociology of Mass Communication. An analysis of the role of radio, the press, magazines, movies, and television in modern societies. An examination of the selective audiences, content characteristics, controlling elements, and organizational structure of the various media of mass communication. One course. *Gilmore.* 1:20-2:40. 9.127.

247. Community and Society. This course seeks to provide a frame of reference for the analysis and ordering of facts pertaining to the diverse cultures of the world, the State, the world community, the Great Society, news, mass behavior, social problems, races, and classes. One course (3 graduate units). *Borinski.* 11:20-12:40. 9.248.

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. One course (3 graduate units). *Borinski.* 9:40-11:00. 9.248.

Zoology

Professor Fluke, *Chairman* (227 Biological Sciences); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences); Associate Professor Ward, *Director of Undergraduate Studies* (032 Biological Sciences)

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking B.A., B.S., M.A., or Ph.D. degrees.

Students seeking undergraduate degrees should consult the *Bulletin of Undergraduate Instruction* for a statement of major requirements. A departmental handbook available from the office of the Director of Undergraduate Studies describes the advising system, typical courses of study, special programs, and interests and background of the faculty.

In general, a graduate student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology, along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology and Anthropology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For registration dates see General Registration, page 29 of this *Bulletin*. For detailed instructions and further information on the offerings at Beaufort, see the *Bulletin of the Duke University Marine Laboratory*.

First Term (Durham Campus)

108. Developmental and Comparative Anatomy of Vertebrates. Lectures and laboratory on the embryology, anatomy, and evolution of vertebrate organ systems. Not open to students who have had Zoology 53 or 56. Prerequisite: introductory college biology. One lab course. *Staff*. 9:40-11:00. Laboratory 1:30-5:00. Lecture, 58.130; lab, 58.219.

151. Principles of Physiology. An introductory survey. Prerequisites: introductory college biology and a year of chemistry. Laboratory included. One lab course. *Staff*. 9:40-11:20. Laboratory 2:00-5:00 Monday, Wednesday, and Friday. Lecture, 58.113; lab, 58.234.

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff*.

353. Research. Hours to be arranged. 2-6 units. *Staff*.

First Term (Duke Marine Laboratory, Beaufort)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff*.

353. Research. Hours to be arranged. 2-6 units. *Staff*.

Second Term (Durham Campus)

117. Heredity and Society. An introduction to genetics, with emphasis on the effects of environment and heredity upon the individual and population. A student may not receive credit for both Zoology 117 and 71 or 180. Prerequisite: introductory college biology or consent of the instructor. One course. *Ward*. 9:40-11:20. 58.113.

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff*.

354. Research. Hours to be arranged. 2-6 units. *Staff*.

Second Term (Duke Marine Laboratory, Beaufort)

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff*.

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra- and inter-specific relationships; community ecology. Readings, discussion, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology or the equivalent, and a year of mathematics; some knowledge of statistics will be helpful. Two courses (6 graduate units). *Sutherland.*

240. Chemical Oceanography. Physicochemical properties of seawater. Lectures, laboratory work, and field trips. Prerequisite: a year of analytical or physical chemistry, an introductory course in general or physical oceanography or permission of the instructor. (Also listed as Chemistry 240.) Two courses (6 graduate units). *Baier.*

250. Physiological Ecology of Marine Animals. A study of the physiological responses of marine animals in relation to certain environmental factors and evolution. Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology. Two courses (6 graduate units). *Forward.*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. (Also listed as Biochemistry 276). Two courses (6 graduate units). *Sullivan.*

278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Two courses (6 graduate units). *Bookhout.*

354. Research. Hours to be arranged. 2-6 units. *Staff.*

Third Term (Durham Campus)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

225. Introduction to Field Zoology. The study of animals in their native habitats with emphasis on habitats, collection, identification, life histories, and ecological relationships. Attention will be paid to familiarizing teachers with animals in the field. Field work will be limited to the Piedmont. Practical uses of field studies in teaching will be stressed. Prerequisite: Zoology 211, Zoology for Teachers (formerly Zoology S205), or equivalent. (Restricted to students in the MAT and NSF programs.) *Staff.* Daily 1:00-5:00. 58.113 (lab, 58.115).

353. Research. Hours to be arranged. 2-6 units. *Staff.*

Third Term (Duke Marine Laboratory, Beaufort)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. Two courses (6 graduate units). *Salmon.*

212. Marine Membrane Physiology. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiological processes. The course will include laboratory work on functions, mechanisms, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Prerequisite: permission of instructor. (Also listed as Physiology 212.) *Gutknecht and Others.*

214. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology. Some work at sea aboard the research vessel. Prerequisites: a course in invertebrate zoology, ecology, marine biology or an appropriate equivalent; chemistry through organic; and one year of physics and mathematics. Two courses (6 graduate units). *Barber.*

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips included. Not open to students who have had zoology 275. Prerequisite: introductory college biology. Two courses (6 graduate units). *Staff.*

277. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals; primarily invertebrates. Prerequisite: one course in physiology. Two courses (6 graduate units). *Hagadorn.*

353. Research. Hours to be arranged. 2-6 units. *Staff.*

Information to Accompany Duke University Summer Session Residence Hall Application

Application for room and apartment reservations and all correspondence concerning reservations should be addressed as appropriate to: Department of Housing Management, House D, Room 101-R, Duke Station, Durham, North Carolina 27706, or Business Manager, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Room rent is payable in advance. No deductions from grants, scholarships, etc., can be made to pay rents.

Room and apartment assignments will be made only upon the applicant's admission to the summer session, as certified by the Summer Session Office, and *upon payment of full rent.* Applicants who expect to be in residence for longer than one term of the summer session are urged to make advance reservation for the entire period and thus avoid, to the extent that housing arrangements make it practicable, the necessity of moving from one room to another during the full term of residence.

See page 25 of the *Bulletin of the Summer Session* for information concerning refund of fees.

When no single rooms are available, a person requesting a single room will be assigned a double room alone and charged room rent as stated on the next page.

Requests for specific roommates will be complied with, provided the completed application forms of both applicants indicate mutual agreement and are on hand in the Department of Housing Management at the time of room assignment. If the applicant requests a double room but gives no preference of roommate, the Department of Housing Management will try to assign a roommate.

Please Retain This Sheet
See Reverse

Residence Hall Rooms—Rates

UNDERGRADUATE AND GRADUATE RESIDENCE HALLS

Few and Edens Quadrangles

Single	Double
15 weeks—$322.50	15 weeks—$240.00
10 weeks—$215.00	10 weeks—$160.00
9 weeks—$193.50	9 weeks—$144.00
8 weeks—$172.00	8 weeks—$128.00
5 weeks—$107.50	5 weeks—$ 80.00
4 weeks—$ 86.00	4 weeks—$ 64.00
1 week —$ 21.50	1 week —$ 16.00

TOWN HOUSE APARTMENTS (GRADUATE STUDENTS)* DUKE-LEASED APARTMENTS (ALL STUDENTS)

$22 each student per week (three to an apartment)
$33 each student per week (two to an apartment)

* Not assigned for less than four weeks. Air-conditioned. Special rates will be quoted for families. A $50 residential deposit is required of families occupying apartments.

DUKE UNIVERSITY MARINE LABORATORY

Each Term, Per Person

Double Room (Non-Air-conditioned)	$59.00
Double Room (Air-conditioned)	$75.00
Triple Room (Air-conditioned)	$54.00

Refund of Housing Fees. Refunds are made under the following circumstances:

1. When notification for a housing cancellation is received by Department of Housing Management on or before twenty (20) days prior to the first day of scheduled classes of summer session term, full housing fees will be refunded.
2. When notification for a housing cancellation is received between the twenty (20) days prior to the first day of scheduled classes and the first two class days, 80 percent of the housing fee will be refunded.
3. When notification for a housing cancellation is received after the first two days of a summer session term, 70 percent of the housing fee for the unused period will be refunded.

Duke University Summer Session: Application for Housing

Please Print

Male ☐ Graduate ☐

Name .... Female ☐ Undergraduate ☐

Mailing Address .... Permanent Address ....

....

Present Position .... City ....

Anticipated fields of study: (1) .... (2) ....

Accommodations Desired

Room: Single Double Duke Marine Laboratory Only: Triple

Town House Apts.: Unaccompanied Students ...; Family* No. Persons
(Graduates and Families Only)

Duke-leased Apts.: Unaccompanied Students ...; Family* No. Persons
(All Students and Families)

Name of roommate(s) preferred: ....

Number of weeks enrolled Date of arrival at Duke At Beaufort

Enclosed is check/money order payable to *Duke University* in amount of $ ....

(Total payment required with application. No assignments will be made until full remittance is received. Please ensure that your remittance covers the specific number of weeks you will be in residence.)

*A $50 residential deposit is required of families occupying apartments.

Signature

Mail completed application and check as appropriate to:

Department of Housing Management
Duke University, Duke Station
Durham, North Carolina 27706

Business Manager
Duke University Marine Laboratory
Beaufort, North Carolina 28516

NOTE: You will be notified of your assignment and the date of occupancy as early as possible, but within three weeks of the desired date of arrival at Duke.

Directions to Summer Session Applicants

All applicants for Summer Session courses who are not now in residence at Duke University must fill out accurately and in detail the form below and return it to the Director of the Summer Session. Preference in enrollment will be given to persons returning the form promptly, but a place in a particular course cannot be assured until all fees are paid. Undergraduates or graduates who are enrolled in a university or college other than Duke University and who are seeking to transfer summer session credits to the college in which they are matriculated should request a course approval form to be certified by their dean or registrar. Graduate students are reminded that credit earned as an unclassified graduate student cannot be applied toward an advanced degree at Duke University. Persons applying for admission to the Graduate School of Duke University should write the Dean of the Graduate School for the necessary forms in addition to completing the form below.

No. Approved Date

Application for Enrollment in the Duke University Summer Session

Mr., Mrs., Miss

(Please Print)

Street Address, Rural Route, or P. O. Box

Post Office State Zip Code

Social Security No.

Please register me in the following courses listed in the *Bulletin of the Summer Session.*

Department	No. of Course	Title of Course

Name and address of high school from which you graduated

Have you attended a college? Yes No

Name and address of college

Highest degree held

Are you a candidate for a degree? Yes No

If yes, for which degree?

Check the one below which indicates your present University status. (Do not indicate a status in a Duke University School or College unless you have already been admitted to that School or College)

Undergraduate credits

☐ Trinity College of Arts and Sciences
☐ School of Nursing
☐ School of Engineering
☐ Special or unclassified
☐ Credits for transfer

Graduate credits

☐ Graduate School
☐ Divinity School
☐ School of Forestry
☐ Special or unclassified
☐ Credits for transfer

Are you applying for admission to the Graduate School?

Are you at present a college student? If so, where?

What class?

Are you a full-time teacher?

If so, give name and address of school

Teaching Position:

Elementary:

Secondary:

Administrator:

Supervisor:

Have you attended previous Summer Sessions at Duke? Yes

Years No

Do you wish credit certified to some agency or school?

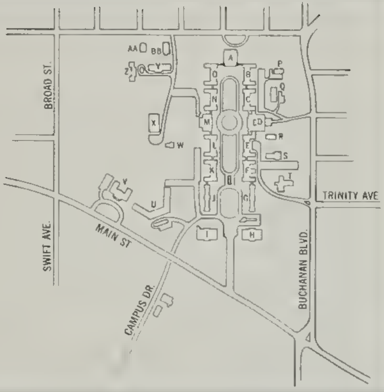
Yes: No:

If yes, please give exact name and address of agency or school.

AP OF DUKE UNIVERSITY

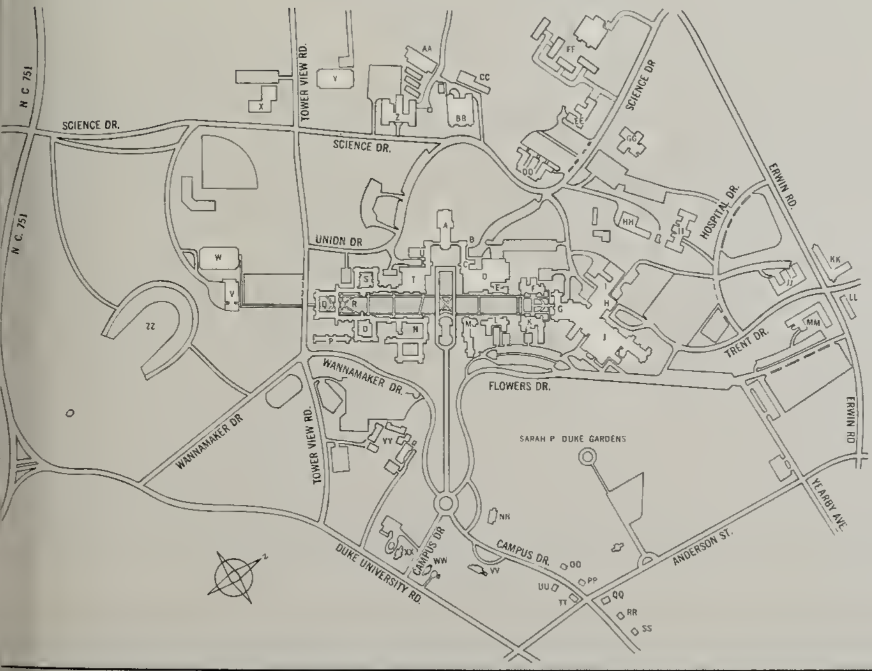
East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laboratory
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanaline H Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Program
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



BULLETIN OF DUKE UNIVERSITY
Summer Session

Vol. 45 No. 5 January 1973

Bulletin of Duke University 1973-1974

Graduate School

Bulletin of Duke University

Graduate School

1973-1974

Durham, North Carolina 1973

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Calendar of the Graduate School 1973-74

Summer Session 1973

April

3-4 Tuesday-Wednesday—Registration for fall and summer, 1973.
13 Friday—Final date for completing application for admission to the summe session, Term I.

May

11 Friday—Completion of Registration for Term I.
14 Monday—First class day except for undergraduate courses in chemistry geology, and physics.
15 Tuesday—Final date for completing application for admission to th summer session, Term II.
19 Saturday—Classes will be held.
21 Monday—First class day for chemistry, geology, and physics.
26 Saturday—Classes will be held.

June

11 Monday—Final date to register for English examination. Registration i taken in the Graduate School Office. This examination is open to student eligible to use English as a foreign language.
14-15 Thursday-Friday—Final examinations for Term I.
15 Friday—Completion of registration for Term II.
15 Friday—Final date for completing application for admission to the summe session, Term III.
15 Friday—Examination for students electing English for a foreign languag requirement; room and hours to be announced.
18 Monday—First class day for all courses in Term II.
23 Saturday—Classes will be held.
30 Saturday—Classes will be held.

July

19-20	Thursday-Friday—Final examinations for Term II.
20	Friday—Completion of registration for Term III.
23	Monday—First class day for Term III.
28	Saturday—Classes will be held.

August

1	Wednesday—Final date for filing with the Graduate School Office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention.
11	Saturday—Classes will be held.
15	Wednesday, 12:00 p.m.—Last day for submitting theses for advanced degrees.
23-24	Thursday-Friday—Final examinations for Term III.
24	Friday—Final date for completion of requirements for Graduate School degrees to be awarded September 1.

Academic Year 1973-74

27-29	Monday-Wednesday—Enrollment in the Graduate School Office for new students.
27-30	Monday-Thursday—Consultation with directors of graduate study concerning course program.
29	Wednesday—English examination for foreign students; 2:00 p.m., 111 Biological Sciences Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
31	Friday—Registration for new and non-registered returning students.

September

4	Tuesday, 9:00 a.m.—Fall semester classes begin.
14	Friday—Final date for changes in registration which involve adding courses, provided no reduction in fees is entailed.
28	Friday—Final date for dropping course-seminar registration and adding equivalent units of research.

October

5	Friday—Final date for change in registration resulting from passing a preliminary examination.
24	Wednesday—Final date to register for English examination. Registration is taken in the Graduate School Office. This examination is open only to students eligible to use English as a foreign language requirement.
29-30	Monday-Tuesday—Registration for spring, 1974.
31	Wednesday—Examination for students electing English for a foreign language requirement; room and hours to be announced.

November

20	Tuesday, 6:00 p.m.—Thanksgiving recess begins.
26	Monday, 9:00 a.m.—Classes are resumed.
30	Friday—Final date for applying for admission to the spring semester.

December

7-13	Friday-Thursday—Reading Period.
9	Sunday—Founders' Day.
14	Friday—Final examinations begin.
21	Friday—Final examinations end.

January

9	Wednesday—English examination for foreign students; 2:00 p.m., 30 Flowers Building. (See chapter on Admission for section on Additiona Procedures for Foreign Students.)
11	Friday—Registration for new and non-registered returning students.
14	Monday, 9:00 a.m.—Spring semester classes begin.
25	Friday—Final date for changes in registration which involve addin courses, provided that no reduction in fees is entailed.

February

1	Friday—Final date for filing with the Graduate School Office the Statement of Intention of receiving an advanced degree in May. Titles o theses and dissertations are to be filed concurrently with the Statemen of Intention.
8	Friday—Final date for dropping course-seminar registration and addin equivalent units of research.
15	Friday—Final date for change in registration resulting from passing preliminary examination.

March

8	Friday—Final date to register for English examination. Registration i taken in the Graduate School Office. This examination is open only t students eligible to use English as a foreign language requirement.
15	Friday—Examination for students electing English for a foreign languag requirement; room and hours to be announced.
15	Friday, 6:00 p.m.—Spring recess begins.
25	Monday, 9:00 a.m.—Classes are resumed.

April

1	Monday—Last day for submitting dissertations for degrees of Doctor o Philosophy and Doctor of Education.
2-3	Tuesday-Wednesday—Registration for fall and summer, 1974.
15	Monday—Last day for applying for admission to the summer session, Term I, 1974.
16	Tuesday—Last day for submitting theses for degrees of Master of Arts, Master of Science, Master of Education, and Master of Arts in Teaching.
23-29	Tuesday-Monday—Reading period.
30	Tuesday—Final examinations begin.

May

7	Tuesday—Final examinations end.
11	Saturday—Commencement begins.
12	Sunday—Commencement Sermon and Graduation Exercises.
15	Wednesday—Final date for completing application for admission to the summer session, Term II, 1974.

University Administration

General Administration

Terry Sanford. J.D., LL.D., D.H., L.H.D., D.P.A., *President*
John O. Blackburn, Ph.D., *Chancellor*
Frederic N. Cleaveland, Ph.D., *Provost*
Charles B. Huestis, *Vice President for Business and Finance*
William G. Anlyan, M.D., *Vice President for Health Affairs*
Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*
J. Peyton Fuller, A.B., *Controller*
Harold W. Lewis, Ph.D., *Vice Provost and Dean of the Faculty*
John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*
Robert C. Krueger, D.Phil., *Vice Provost and Dean of Trinity College of Arts and Sciences*
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*
Benjamin Edward Powell, Ph.D., *Librarian*
Clark R. Cahow, Ph.D., *University Registrar*
Victor A. Bubas, B.S., *Assistant to the President*
Rufus H. Powell, LL.B., *Secretary of the University*
A. Kenneth Pye, LL.M., *University Counsel*

Graduate School Administration

John C. McKinney, Ph.D., *Dean of the Graduate School*
Dale B. J. Randall, Ph.D., *Associate Dean*
Charles M. Harman, Ph.D., *Associate Dean*
Leesa H. Campbell, M.A., *Assistant to the Dean*
Frances C. Thomas, A.B., *Administrative Assistant*

Executive Committee of the Graduate Faculty

Dean John C. McKinney

William H. Cartwright
Lawrence E. Evans*
Walter R. Guild
George L. Maddox*
Aubrey W. Naylor (Alt.)
Loren Nolte
Holger O. Nygard
John F. Oates*
Harry B. Partin (Alt.)
Joachim R. Sommer*
Seth L. Warner (Alt.)
Charles R. Young (Alt.)

* Term expires September, 1973.

Instructional Staff

Members of the Graduate School Faculty

(As of October 1, 1972.)

The date denotes the first year of service at Duke University.

Frances Dorothy Acomb (1945), Ph.D., *Associate Professor of History*
Anne H. Adams (1971), Ed.D., *Associate Professor of Education*
Dolph O. Adams (1972), M.D., Ph.D., *Assistant Professor of Pathology*
Mark Adelman (1971), Ph.D., *Assistant Professor of Anatomy*
David Aderman (1970), Ph.D., *Assistant Professor of Psychology*
John Richard Alden (1955), Ph.D., *James B. Duke Professor of History*
Carole A. Aldrich (1970), Ph.D., *Assistant Professor of Business Administration*
Irving Alexander (1963), Ph.D., *Professor of Psychology*
A. Tilo Alt (1961-65; 1967), Ph.D., *Assistant Professor of German*
D. Bernard Amos (1962), M.D., *James B. Duke Professor of Immunology*
Carl Anderson (1955), Ph.D., *Professor of English*
Lewis Edward Anderson (1936), Ph.D., *Professor of Botany*
Nels C. Anderson (1966), Ph.D., *Assistant Professor of Physiology*
Roger Fabian Anderson (1950), Ph.D., *Professor of Forest Entomology*
Janis Antonovics (1970), Ph.D., *Associate Professor of Botany*
Stanley Hersh Appel (1964-65; 1967), M.D., *Associate Professor of Biochemistry*
Mahadeo L. Apte (1965), Ph.D., *Associate Professor of Anthropology*
Richard E. Aquila (1968), Ph.D., *Assistant Professor of Philosophy*
John Leslie Artley (1955), D.Eng., *Professor of Electrical Engineering*
Louis E. Auld (1970), Ph.D., *Assistant Professor of Romance Languages*
Kurt W. Back (1959), Ph.D., *Professor of Sociology*
Rodger W. Baier (1972), Ph.D., *Assistant Professor of Chemistry*
Joseph Randle Bailey (1946), Ph.D., *Professor of Zoology*
Lloyd Richard Bailey (1971), Ph.D., *Associate Professor of Religion*
Frank Baker (1960), Ph.D., *Professor of Religion*
Steven W. Baldwin (1970), Ph.D., *Assistant Professor of Chemistry*
Helmy Hamdollah Baligh (1967), Ph.D., *Professor of Business Administration*
M. Margaret Ball (1963), Ph.D., *Professor of Political Science*
Robert H. Ballantyne (1962), Ed.D., *Associate Professor of Education*
James David Barber (1972), Ph.D., *Professor of Political Science*
Richard T. Barber (1970), Ph.D., *Associate Professor of Zoology*

Sabbatical leave, spring semester, 1973.

Robert Lloyd Barnes (1965), Ph.D., *Professor of Forest Biochemistry*
Roger Barr (1968), Ph.D., *Associate Professor of Biomedical Engineering*
Joseph Battle (1970), Ph.D., *Associate Professor of Business Administration*
William Waldo Beach (1946), Ph.D., *Professor of Christian Ethics*
Robert Bell (1972), Ph.D., *Assistant Professor of Biochemistry*
Theodore Benditt (1970), Ph.D., *Assistant Professor of Philosophy*
Peter B. Bennett (1972), Ph.D., *Professor of Biomedical Engineering*
Jan Bergeron (1968), V.M.D., *Assistant Professor of Anatomy*
Frederick Bernheim (1930), Ph.D., *James B. Duke Professor of Pharmacology*
[2] Mary L. C. Bernheim (1930), Ph.D., *Professor of Biochemistry*
L. C. Biedenharn, Jr. (1961), Ph.D., *Professor of Physics*
Darrell D. Bigner (1972), M.D., Ph.D., *Assistant Professor of Pathology*
[3] William Dwight Billings (1952), Ph.D., *James B. Duke Professor of Botany*
[4] Edward George Bilpuch (1962), Ph.D., *Professor of Physics*
J. A. Bittikofer (1971), Ph.D., *Associate in Biochemistry*
David E. Black (1970), Ph.D., *Assistant Professor of Economics*
Charles Blake (1972), Ph.D., *Assistant Professor of Anatomy*
John O. Blackburn (1962), Ph.D., *Professor of Economics*
[5] William F. Blankley (1972), Ph.D., *Assistant Professor of Botany*
J. J. Blum (1962), Ph.D., *Professor of Physiology*
Dani P. Bolognesi (1971), Ph.D., *Assistant Professor of Microbiology*
Joseph Bonaventura (1972), Ph.D., *Associate Professor of Biochemistry*
Cazlyn Green Bookhout (1935), Ph.D., *Professor of Zoology*
Frank Borchardt (1971), Ph.D., *Associate Professor of German*
Lloyd J. Borstelmann (1953), Ph.D., *Professor of Medical Psychology*
Edward H. Bossen (1972), M.D., *Assistant Professor of Pathology*
[6] Francis Ezra Bowman (1945), Ph.D., *Professor of English*
John E. Boynton (1968), Ph.D., *Associate Professor of Botany*
William D. Bradford (1965), M.D., *Associate Professor of Pathology*
David G. Bradley (1949), Ph.D., *Professor of Religion*
Charles Kilgo Bradsher (1939), Ph.D., *James B. Duke Professor of Chemistry*
[7] Ralph Braibanti (1953), Ph.D., *James B. Duke Professor of Political Science*
Eleanor F. Branch (1972), Ph.D., *Associate Professor of Physical Therapy*
Jack Brehm (1958), Ph.D., *Professor of Psychology*
Mary Lee Brehm (1965), Ph.D., *Assistant Professor of Sociology*
Gert Brieger (1970), M.D., Ph.D., *Associate Professor of History*
[8] Martin Bronfenbrenner (1971), Ph.D., *Professor of Economics*
Earl Ivan Brown, II (1960), Ph.D., *J. A. Jones Professor of Civil Engineering*
Frances Campbell Brown (1931), Ph.D., *Professor of Chemistry*
C. Edward Buckley, III (1963), M.D., *Associate Professor of Immunology*
Rebecca Buckley (1968), M.D., *Associate Professor of Immunology*
[9] Louis J. Budd (1952), Ph.D., *Professor of English*
John Buettner-Janusch (1965), Ph.D., *Professor of Anatomy and Professor of Zoology*
Donald S. Burdick (1962), Ph.D., *Associate Professor of Mathematics*
[10] Peter H. Burian (1968), Ph.D., *Assistant Professor of Classics*
R. O. Burns (1964), Ph.D., *Professor of Microbiology*
Richard M. Burton (1970), D.B.A., *Associate Professor of Business Administration*
Ronald Richard Butters (1967), Ph.D., *Assistant Professor of English*
[11] Gale H. Buzzard (1957), Ph.D., *Assistant Professor of Mechanical Engineering*
Peter F. Carbone (1966), Ed.D., *Associate Professor of Education*
Leonard Carlitz (1932), Ph.D., *James B. Duke Professor of Mathematics*
Robert C. Carson (1960), Ph.D., *Professor of Psychology*

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[2] Retired, August 31, 1972.
[3] Sabbatical leave, spring semester, 1973.
[4] Leave of absence, fall semester, 1972.
[5] Leave of absence, academic year, 1972-73.
[6] Retired, August 31, 1972.
[7] Sabbatical leave, spring semester, 1973.
[8] Sabbatical leave, spring semester, 1973.
[9] Sabbatical leave, academic year, 1972-73.
[10] Leave of absence, academic year, 1972-73.
[11] Sabbatical leave, fall semester, 1972.

Matthew Cartmill (1970), Ph.D., *Assistant Professor of Anatomy and Assistant Professo of Anthropology*
William H. Cartwright (1951), Ph.D., *Professor of Education*
Ernesto Caserta (1971), Ph.D., *Assistant Professor of Romance Languages*
John H. Cassedy (1970), Ph.D., *Lecturer in Psychology*
Ronald W. Casson (1971), Ph.D., *Assistant Professor of Anthropology*
John Cell (1962), Ph.D., *Associate Professor of History*
[12] Jack B. Chaddock (1966), Sc.D., *Professor of Mechanical Engineering*
William Chafe (1971), Ph.D., *Assistant Professor of History*
Roger C. Chapman (1969), M.S., *Assistant Professor of Biometry*
James H. Charlesworth (1969), Ph.D., *Assistant Professor of Religion*
Donald B. Chesnut (1965), Ph.D., *Professor of Chemistry*
Edgar W. Clark (1970), Ph.D., *Adjunct Associate Professor of Forest Entomology*
Henry B. Clark (1966), Ph.D., *Associate Professor of Religion*
Howard G. Clark (1968), Ph.D., *Associate Professor of Biomedical Engineering and Professor of Mechanical Engineering*
Frederic N. Cleaveland (1972), Ph.D., *Professor of Political Science*
Edward Clifford (1965), Ph.D., *Lecturer in Psychology*
Gerald Wayne Clough (1969), Ph.D., *Assistant Professor of Civil Engineering*
John Clubbe (1966), Ph.D., *Associate Professor of English*
Franklin H. Cocks (1972), Ph.D., *Associate Professor of Mechanical Engineering*
David Coder (1970), Ph.D., *Assistant Professor of Philosophy*
John D. Coie (1968), Ph.D., *Assistant Professor of Psychology*
Robert Taylor Cole (1935), Ph.D., *James B. Duke Research Professor of Political Science*
Joel Colton (1947), Ph.D., *Professor of History*
Robert Merle Colver (1953), Ed.D., *Associate Professor of Education*
Norman Francis Conant (1935), Ph.D., *James B. Duke Professor of Microbiology*
Judith Conger (1971), Ph.D., *Visiting Assistant Professor of Psychology*
Frank J. Convery (1972), Ph.D., *Assistant Professor of Forest Economics*
[13] Samuel D. Cook (1966), Ph.D., *Professor of Political Science*
Thomas Howard Cordle (1950), Ph.D., *Professor of Romance Languages*
Philip Robert Costanzo (1968), Ph.D., *Assistant Professor of Psychology*
John Costlow (1959), Ph.D., *Professor of Zoology*
[14] Sheila J. Counce (1968), Ph.D., *Associate Professor of Anatomy*
Dario Covi (1970), Ph.D., *Professor of Art*
Elaine Crovitz (1965), Ph.D., *Lecturer in Psychology*
Herbert F. Crovitz (1963), Ph.D., *Lecturer in Psychology*
Alvin L. Crumbliss (1970), Ph.D., *Assistant Professor of Chemistry*
Chicita F. Culberson (1971), Ph.D., *Lecturer in Botany*
William L. Culberson (1955), Ph.D., *Professor of Botany*
Ronald Y. Cusson (1970), Ph.D., *Associate Professor of Physics*
Robert Earle Cushman (1945), Ph.D., *Professor of Systematic Theology*
Jarir Dajani (1971), Ph.D., *Assistant Professor of Civil Engineering*
William W. Damon (1970), Ph.D., *Assistant Professor of Business Administration*
Charles Daniels (1971), M.D., Ph.D., *Assistant Professor of Pathology*
David G. Davies (1961), Ph.D., *Professor of Economics*
William D. Davies (1966), D.D., *George Washington Ivey Professor of Advanced Studies and Research in Christian Origins*
Calvin D. Davis (1962), Ph.D., *Associate Professor of History*
[15] Gifford Davis (1930), Ph.D., *Professor of Romance Languages*
Lucy Davis (1969), Ed.D., *Associate Professor of Education*
Eugene Davis Day (1962), Ph.D., *Professor of Immunology*
David C. Dellinger (1968), Ph.D., *Associate Professor of Business Administration*
Frank C. DeLucia (1969), Ph.D., *Assistant Professor of Physics*
Neil de Marchi (1971), Ph.D., *Assistant Professor of Economics*
A. Leigh DeNeef (1969), Ph.D., *Assistant Professor of English*
Frank Traver de Vyver (1935), Ph.D., *Professor of Economics*
Irving Diamond (1958), Ph.D., *James B. Duke Professor of Psychology*

[12] Sabbatical leave, spring semester, 1973.
[13] Leave of absence, academic year, 1972-73.
[14] Leave of absence, September 1, 1972 through June 30, 1973.
[15] Sabbatical leave, spring semester, 1973.

Joseph Di Bona (1967), Ph.D., *Associate Professor of Education*
Frank C. Dorsey (1972), Ph.D., *Assistant Professor of Pathology*
Francis George Dressel (1929), Ph.D., *Professor of Mathematics*
Bernard I. Duffey (1963), Ph.D., *Professor of English*
Kenneth Lindsay Duke (1940), Ph.D., *Associate Professor of Anatomy*
Robert F. Durden (1952), Ph.D., *Professor of History*
Jiri Dvorak (1967), C.Sc., Ph.D., *Associate Professor of Civil Engineering*
Jane G. Elchlepp (1960), M.D., Ph.D., *Associate Professor of Pathology*
Albert Eldridge (1970), Ph.D., *Assistant Professor of Political Science*
Howard L. Elford (1969), Ph.D., *Assistant Professor of Pharmacology*
Ernest Elsevier (1950), M.S., *Associate Professor of Mechanical Engineering*
Ainslie T. Embree (1968), Ph.D., *Visiting Professor of History*
Carl Erickson (1966), Ph.D., *Associate Professor of Psychology*
Harold Erickson (1970), Ph.D., *Assistant Professor of Anatomy*
Robert P. Erickson (1961), Ph.D., *Associate Professor of Psychology*
J. D. G. Evans (1972), Ph.D., *Visiting Associate Professor of Philosophy*
Lawrence Evans (1963), Ph.D., *Associate Professor of Physics*
John Wendell Everett (1932), Ph.D., *Professor of Anatomy*
[16] Henry A. Fairbank (1961), Ph.D., *Professor of Physics*
John Morton Fein (1950), Ph.D., *Professor of Romance Languages*
Robert E. Fellows, Jr. (1966), M.D., Ph.D., *Associate Professor of Physiology*
Arthur Bowles Ferguson (1939), Ph.D., *Professor of History*
Oliver Ferguson (1957), Ph.D., *Professor of English*
Bernard F. Fetter (1951), M.D., *Professor of Pathology*
Peter G. Fish (1969), Ph.D., *Associate Professor of Political Science*
Anne Flowers (1972), Ed.D., *Associate Professor of Education*
Donald J. Fluke (1957), Ph.D., *Professor of Zoology*
Lloyd R. Fortney (1964), Ph.D., *Associate Professor of Physics*
Richard B. Forward (1971), Ph.D., *Assistant Professor of Zoology*
Wallace Fowlie (1964), Ph.D., *James B. Duke Professor of Romance Languages*
Richard G. Fox (1968), Ph.D., *Associate Professor of Anthropology*
Irwin Fridovich (1958), Ph.D., *Professor of Biochemistry*
Carl J. Friedrich (1973), Ph.D., *Visiting Distinguished Professor of Political Science*
William J. Furbish (1954), M.S., *Associate Professor of Geology*
Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., *Professor of Computer Science*
Devendra P. Garg (1972), Ph.D., *Professor of Mechanical Engineering*
Raymond Gavins (1971), Ph.D., *Assistant Professor of History*
Ila Gehman (1959), Ed.D., *Lecturer in Psychology*
W. Scott Gehman, Jr. (1954), Ph.D., *Professor of Psychology in Education*
John T. Gentry (1970), M.P.H., M.D., *Adjunct Professor of Health Administration*
W. Doyle Gentry (1969), Ph.D., *Lecturer in Psychology*
Rhett Truesdale George, Jr. (1957), Ph.D., *Assistant Professor of Electrical Engineering*
Gerald E. Gerber (1962), Ph.D., *Associate Professor of English*
Robert G. Ghirardelli (1972), Ph.D., *Adjunct Associate Professor of Chemistry*
Nicholas W. Gillham (1968), Ph.D., *Associate Professor of Zoology*
Sherwood Githens (1962), Ph.D., *Professor of Education*
[17] Craufurd Goodwin (1962), Ph.D., *Professor of Economics*
Lawrence C. Goodwyn (1971), Ph.D., *Adjunct Assistant Professor of History*
Walter Gordy (1946), Ph.D., LL.D., D.H.C., *James B. Duke Professor of Physics*
Henry Grabowski (1972), Ph.D., *Associate Professor of Economics*
Daniel A. Graham (1969), Ph.D., *Assistant Professor of Economics*
Ronald C. Greene (1958), Ph.D., *Associate Professor of Biochemistry*
Joseph C. Greenfield (1963), M.D., *Assistant Professor of Physiology and Pharmacology*
John R. Gregg (1957), Ph.D., *Professor of Zoology*
Eugene Grueling (1948), Ph.D., *Professor of Physics*
Samson Gross (1960), Ph.D., *Professor of Genetics and Biochemistry*
Kazimierz Grzybowski (1967), S.J.D., *Professor of Political Science*
Walter R. Guild (1960), Ph.D., *Professor of Biophysics*
Robert Burns Gunn (1971), M.D., *Professor of Physiology*
John Gutknecht (1969), Ph.D., *Assistant Professor of Physiology and Pharmacology*

[16] Sabbatical leave, spring semester, 1973.
[17] Leave of absence, half-time, academic year, 1972-73.

William F. Gutknecht (1971), Ph.D., *Assistant Professor of Chemistry*
Norman Guttman (1951), Ph.D., *Professor of Psychology*
Robert L. Habig (1968), Ph.D., *Assistant Professor of Biochemistry*
Donald B. Hackel (1960), M.D., *Professor of Pathology*
Herbert Hacker, Jr. (1965), Ph.D., *Associate Professor of Electrical Engineering*
Robert Hagerman (1971), Ph.D., *Assistant Professor of Business Administration*
Dwight H. Hall (1968), Ph.D., *Assistant Professor of Biochemistry*
[18] Hugh Marshall Hall, Jr. (1953), Ph.D., *Professor of Political Science*
Louise Hall (1931), S.B.Arch., Ph.D., *Professor of Architecture*
William C. Hall (1970), Ph.D., *Assistant Professor of Anatomy and Assistant Professor of Psychology*
John Hamilton Hallowell (1942), Ph.D., *Professor of Political Science*
[19] William Baskerville Hamilton (1936), Ph.D., *Professor of History*
William E. Hammond (1963), Ph.D., *Associate Professor of Biomedical Engineering*
Moo-Young Han (1967), Ph.D., *Associate Professor of Physics*
[20] Philip Handler (1939), Ph.D., *James B. Duke Professor of Biochemistry and Nutrition*
Frank Allan Hanna (1948), Ph.D., *Professor of Economics*
Charles Morgan Harman (1961), Ph.D., *Professor of Mechanical Engineering*
Ellwood Scott Harrar (1936), Ph.D., *James B. Duke Professor of Wood Science*
Philip D. Harriman (1968), Ph.D., *Assistant Professor of Biochemistry*
Jerome S. Harris (1936), M.D., *Associate Professor of Biochemistry*
Robert B. Hartford (1968), Ph.D., *Assistant Professor of Sociology*
[21] Gerald Hartwig (1971), Ph.D., *Assistant Professor of History*
Willis F. Hawley (1972), Ph.D., *Assistant Professor of Political Science*
William S. Heckscher (1966), Ph.D., *Benjamin N. Duke Professor of Art*
Thomas M. Havrilesky (1969), Ph.D., *Associate Professor of Economics*
Henry Hellmers (1965), Ph.D., *Professor of Botany*
Robert William Henkens (1968), Ph.D., *Assistant Professor of Chemistry*
[22] Stuart C. Henry (1959), Ph.D., *Professor of American Christianity*
Charles Henson (1967), Ph.D., *Assistant Professor of Mathematics*
Duncan Heron (1950), Ph.D., *Professor of Geology*
David Guy Herr (1967), Ph.D., *Assistant Professor of Mathematics*
Frederick Herzog (1960), Th.D., *Professor of Systematic Theology*
R. L. Hill (1962), Ph.D., *Professor of Biochemistry*
Brian A. Hills (1969), Ph.D., *Adjunct Associate Professor of Biomedical Engineering*
Frederick R. Hine (1958), M.D., *Associate Professor of Psychology*
Charles Hirschman (1972), Ph.D., *Assistant Professor of Sociology*
George H. Hitchings (1971), Ph.D., *Adjunct Professor of Pharmacology*
Marcus Edwin Hobbs (1935), Ph.D., *Professor of Chemistry*
Richard Earl Hodel (1965), Ph.D., *Associate Professor of Mathematics*
Charles S. Hodges, Jr. (1970), Ph.D., *Adjunct Associate Professor of Forest Pathology*
Irving B. Holley, Jr. (1947), Ph.D., *Professor of History*
Frederic B. M. Hollyday (1956), Ph.D., *Professor of History*
Everett H. Hopkins (1961), M.A., LL.D., *Professor of Education*
James S. House (1970), Ph.D., *Assistant Professor of Sociology*
Alexander Hull (1962), Ph.D., *Associate Professor of Romance Languages*
Allan S. Hurlburt (1956), Ph.D., *Professor of Education*
A. M. J. Hyatt (1972), Ph.D., *Visiting Professor of History*
William Hylander (1972), Ph.D., *Assistant Professor of Anatomy*
[23] Miriam Jacobs (1968), Ph.D., *Assistant Professor of Anatomy*
[24] Wallace Jackson (1965), Ph.D., *Associate Professor of English*
Boi Jon Jaeger (1971), Ph.D., *Associate Professor of Health Administration*
Hugo Jauregui (1970), M.D., Ph.D., *Assistant Professor of Pathology*
Peter W. Jeffs (1964), Ph.D., *Professor of Chemistry*
Marianna Jenkins (1948), Ph.D., *Professor of Art*

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[18] Sabbatical leave, fall semester, 1972.
[19] Deceased, July 17, 1972.
[20] Leave of absence, academic year, 1972-73.
[21] Leave of absence, spring semester, 1973.
[22] Sabbatical leave, academic year, 1972-73.
[23] Leave of absence, May 15, 1972 through May 14, 1973.
[24] Sabbatical leave, spring semester, 1973.

Bronislas de Leval Jezierski (1958), Ph.D., *Associate Professor of Slavic Languages and Literatures*
Frans F. Jöbsis (1964), Ph.D., *Professor of Physiology*
[25] Sheridan Johns, III (1970), Ph.D., *Associate Professor of Political Science*
Charles B. Johnson (1956), Ed.D., *Associate Professor of Education*
Edward Johnson (1963), M.D., *Professor of Physiology and Pharmacology*
Kurt Johnson (1971), Ph.D., *Assistant Professor of Anatomy*
[26] Terry W. Johnson, Jr. (1954), Ph.D., *Professor of Botany*
William W. Johnston (1963), M.D., *Assistant Professor of Pathology*
William Thomas Joines (1966), Ph.D., *Associate Professor of Electrical Engineering*
Wolfgang Karl Joklik (1968), D.Phil., *James B. Duke Professor of Microbiology and Immunology*
Buford Jones (1962), Ph.D., *Associate Professor of English*
Edward Ellsworth Jones (1953), Ph.D., *Professor of Psychology*
James Kalat (1971), Ph.D., *Assistant Professor of Psychology*
Arnold D. Kaluzny (1970), Ph.D., *Adjunct Assistant Professor of Health Administration*
Henry Kamin (1948), Ph.D., *Professor of Biochemistry*
William G. Katzenmeyer (1967), Ed.D., *Associate Professor of Education*
Bernard Kaufman (1968), Ph.D., *Associate Professor of Biochemistry*
Thomas F. Keller (1959), Ph.D., *Professor of Business Administration*
Allen C. Kelley (1972), Ph.D., *Professor of Economics*
William N. Kelley (1969), M.D., *Assistant Professor of Biochemistry*
Van Leslie Kenyon, Jr. (1945), M.M.E., *Professor of Mechanical Engineering*
Alan C. Kerckhoff (1958), Ph.D., *Professor of Sociology*
Robert B. Kerr (1965), Ph.D., *Professor of Electrical Engineering*
Sung-Hou Kim (1970), Ph.D., *Assistant Professor of Biochemistry*
Thomas DeArman Kinney (1960), M.D., *Professor of Pathology*
Marcel Kinsbourne (1967), M.D., *Lecturer in Psychology*
Gary Kirk (1970), Ph.D., *Assistant Professor of Physiology*
Norman Kirshner (1956), Ph.D., *Associate Professor of Biochemistry*
Joseph Weston Kitchen, Jr. (1962), Ph.D., *Associate Professor of Mathematics*
Gordon K. Klintworth (1964), M.D., Ph.D., *Associate Professor of Pathology*
Peter H. Klopfer (1958), Ph.D., *Professor of Zoology*
Kenneth R. Knoerr (1961), Ph.D., *Professor of Forest Meteorology*
Allan Kornberg (1965), Ph.D., *Professor of Political Science*
Wesley A. Kort (1965), Ph.D., *Associate Professor of Religion*
David Paul Kraines (1970), Ph.D., *Assistant Professor of Mathematics*
Paul Jackson Kramer (1931), Ph.D., *James B. Duke Professor of Botany*
Richard B. Kramer (1968), Ph.D., *Assistant Professor of Psychology*
Nicholas Michael Kredich (1968), M.D., *Assistant Professor of Biochemistry*
Irwin Kremen (1963), Ph.D., *Assistant Professor of Psychology*
Juanita M. Kreps (1955), Ph.D., *James B. Duke Professor of Economics*
William R. Krigbaum (1952), Ph.D., *James B. Duke Professor of Chemistry*
Robert Krueger (1961), D.Phil., *Associate Professor of English*
Arnold D. Krugman (1964), Ph.D., *Lecturer in Psychology*
Magnus Jan Krynski (1966), Ph.D., *Associate Professor of Slavic Languages and Literatures*
Arthur J. Kuhn (1971), Ph.D., *Assistant Professor of Business Administration*
Wladyslaw W. Kulski (1963), Dr.Jur., *James B. Duke Professor of Russian Affairs*
Johannes A. Kylstra (1965), M.D., Ph.D., *Associate Professor of Physiology*
Weston LaBarre (1946), Ph.D., *James B. Duke Professor of Anthropology*
Leon Lack (1965), Ph.D., *Professor of Physiology and Pharmacology*
Creighton Lacy (1953), Ph.D., *Professor of Missions and Social Ethics*
[27] Martin Lakin (1958), Ph.D., *Professor of Psychology*
Karla Langedijk (1969), Ph.D., *Lecturer in Art History*
Thomas A. Langford (1956), Ph.D., *Professor of Religion*
[28] John Tate Lanning (1927), Ph.D., *James B. Duke Professor of History*
Peter K. Lauf (1968), M.D., *Associate Professor of Physiology and Assistant Professor of Immunology*

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[25] Leave of absence, fall semester, 1972.
[26] Sabbatical leave, academic year, 1972-73.
[27] Sabbatical leave, academic year, 1972-73.
[28] Retired, August 31, 1972.

Danny J. Laughhunn (1968), Ph.D., *Associate Professor of Business Administration*
Richard H. Leach (1955), Ph.D., *Professor of Political Science*
Harold E. Lebovitz (1959), M.D., *Assistant Professor of Physiology*
Jack A. Lees (1971), Ph.D., *Assistant Professor of Mathematics*
Warren Lerner (1961), Ph.D., *Professor of History*
Harold Walter Lewis (1946), Ph.D., *Professor of Physics*
Melvyn Lieberman (1967), Ph.D., *Assistant Professor of Physiology and Pharmacology*
John L. Lievsay (1962), Ph.D., *James B. Duke Professor of English*
L. Sigfred Linderoth, Jr. (1965), M.E., *Professor of Mechanical Engineering*
Daniel A. Livingstone (1956), Ph.D., *Professor of Zoology*
Charles H. Lochmüller (1969), Ph.D., *Assistant Professor of Chemistry*
Gregory Lockhead (1965), Ph.D., *Professor of Psychology*
James S. Loos (1972), Ph.D., *Assistant Professor of Physics*
William Longley (1968), Ph.D., *Assistant Professor of Anatomy*
Ronald Luftig (1969), Ph.D., *Assistant Professor of Microbiology*
John G. Lundberg (1970), Ph.D., *Assistant Professor of Zoology*
William S. Lynn, Jr. (1954), M.D., *Associate Professor of Biochemistry*
George W. Lynts (1965), Ph.D., *Associate Professor of Geology*
John Nelson Macduff (1956), M.M.E., *Professor of Mechanical Engineering*
Ian Macintyre (1967), Ph.D., *Adjunct Assistant Professor of Geology*
Barry MacKichan (1970), Ph.D., *Assistant Professor of Mathematics*
Kenneth S. McCarty (1959), Ph.D., *Professor of Biochemistry*
David R. McClay (1973), Ph.D., *Assistant Professor of Zoology*
Joe M. McCord (1970), Ph.D., *Associate Professor of Biochemistry*
Marjorie McElroy (1971), Ph.D., *Assistant Professor of Economics*
Patrick A. McKee (1969), M.D., *Assistant Professor of Biochemistry*
John C. McKinney (1957), Ph.D., *Professor of Sociology*
Thomas J. McManus (1961), M.D., *Associate Professor of Physiology*
Andrew T. McPhail (1968), Ph.D., *Associate Professor of Chemistry*
George L. Maddox (1960), Ph.D., *Professor of Sociology*
M. Stephen Mahaley (1965), M.D., Ph.D., *Assistant Professor of Anatomy*
[29] Edward P. Mahoney (1965), Ph.D., *Associate Professor of Philosophy*
Steven Maier (1971), Ph.D., *Assistant Professor of Business Administration*
Peter N. Marinos (1968), Ph.D., *Professor of Electrical Engineering*
Sidney David Markman (1947), Ph.D., *Professor of Art History and Archaeology*
David V. Martin (1962), Ed.D., *Associate Professor of Education*
William Maxwell Mason (1970), Ph.D., *Assistant Professor of Sociology*
Seymour Mauskopf (1964), Ph.D., *Associate Professor of History*
Robert Arthur Maxwell (1971), Ph.D., *Adjunct Professor of Pharmacology*
Elgin W. Mellown, Jr. (1965), Ph.D., *Associate Professor of English*
Lorne Mendell (1968), Ph.D., *Assistant Professor of Physiology*
Daniel B. Menzel (1971), Ph.D., *Associate Professor of Pharmacology*
Louis John Metz (1970), Ph.D., *Adjunct Associate Professor of Forest Soils*
Richard S. Metzgar (1962), Ph.D., *Professor of Immunology*
Johannes Horst Max Meyer (1959), D.Sc., *Professor of Physics*
Eric Meyers (1969), Ph.D., *Associate Professor of Religion*
[30] Martin Miller (1970), Ph.D., *Assistant Professor of History*
Elliott Mills (1968), Ph.D., *Assistant Professor of Physiology*
Gerald Monsman (1965), Ph.D., *Associate Professor of English*
John W. Moore (1961), Ph.D., *Professor of Physiology*
Lawrence C. Moore, Jr. (1966), Ph.D., *Associate Professor of Mathematics*
[31] Montrose J. Moses (1959), Ph.D., *Professor of Anatomy*
Earl George Mueller (1945), Ph.D., *Professor of Art*
Bruce J. Muga (1967), Ph.D., *Associate Professor of Civil Engineering*
Bruce Roy Munson (1970), Ph.D., *Assistant Professor of Mechanical Engineering*
Roland E. Murphy (1967-1968; 1971), S.T.D., *Professor of Religion*
Francis Joseph Murray (1960), Ph.D., *Professor of Mathematics*
George C. Myers (1968), Ph.D., *Professor of Sociology*

[29] Sabbatical leave, academic year, 1972-73.
[30] Leave of absence, academic year, 1972-73.
[31] Sabbatical leave, academic year, 1972-73.

[2] Toshio Narahashi (1965), Ph.D., *Professor of Pharmacology*
Sydney Nathans (1966), Ph.D., *Assistant Professor of History*
Aubrey Willard Naylor (1952), Ph.D., *James B. Duke Professor of Botany*
Thomas H. Naylor (1964), Ph.D., *Professor of Economics and Professor of Computer Science*
[3] Glenn Robert Negley (1946), Ph.D., *Professor of Philosophy*
Henry Winston Newson (1948), Ph.D., *James B. Duke Professor of Physics*
Francis Newton (1967), Ph.D., *Professor of Latin in Classical Studies*
Charles Adam Nichol (1971), Ph.D., *Adjunct Professor of Pharmacology*
Jack L. Nichols (1970), Ph.D., *Assistant Professor of Microbiology*
[4] Robert Bruce Nicklas (1965), Ph.D., *Professor of Zoology*
Robert Niess (1971), Ph.D., *Professor of Romance Languages*
Charles Edwin V. Nixon (1971), Ph.D., *Assistant Professor of Classical Studies*
Loren Nolte (1966), Ph.D., *Professor of Electrical Engineering and Professor of Biomedical Engineering*
Thomas T. Norton (1972), Ph.D., *Assistant Professor of Psychology*
Richey Novak (1970), Ph.D., *Assistant Professor of Germanic Languages*
Yasuhiko Nozaki (1962), Ph.D., *Associate Professor of Biochemistry*
Holger O. Nygard (1960), Ph.D., *Professor of English*
John F. Oates (1967), Ph.D., *Professor of Ancient History in Classical Studies*
William O'Barr (1969), Ph.D., *Assistant Professor of Anthropology*
Walter D. Obrist (1956), Ph.D., *Lecturer in Psychology*
William M. O'Fallon (1965), Ph.D., *Assistant Professor of Mathematics*
Robert T. Osborn (1954), Ph.D., *Professor of Religion*
Suydam Osterhout (1959), M.D., Ph.D., *Professor of Microbiology*
Athos Ottolenghi (1959), M.D., *Associate Professor of Physiology and Pharmacology*
Harry Ashton Owen, Jr. (1951), Ph.D., *Professor of Electrical Engineering*
[5] George M. Padilla (1965), Ph.D., *Associate Professor of Physiology*
[36] David L. Paletz (1967), Ph.D., *Assistant Professor of Political Science*
Aubrey E. Palmer (1944), C.E., *Associate Professor of Civil Engineering*
Richard A. Palmer (1966), Ph.D., *Associate Professor of Chemistry*
Erdman B. Palmore (1967), Ph.D., *Professor of Sociology*
William E. Parham (1972), Ph.D., *R.J. Reynolds Professor of Chemistry*
[37] Harold Talbot Parker (1939), Ph.D., *Professor of History*
Harry Partin (1964), Ph.D., *Associate Professor of Religion*
Merrill Lee Patrick (1964), Ph.D., *Associate Professor of Computer Science*
[38] Lewis Patton (1926), Ph.D., *Professor of English*
Michael I. Pavlov (1960), Ph.D., *Associate Professor of Russian Language*
[39] William Bernard Peach (1951), Ph.D., *Professor of Philosophy*
George Wilbur Pearsall (1964), Sc.D., *Professor of Mechanical Engineering*
Talmage Lee Peele (1939), M.D., *Professor of Anatomy and Lecturer in Psychology*
Ronald D. Perkins (1968), Ph.D., *Associate Professor of Geology*
Anton Peterlin (1962), Ph.D., *Adjunct Professor of Chemistry*
Russell J. Petersen (1971), Ph.D., *Assistant Professor of Business Administration*
[40] Ray C. Petry (1937), Ph.D., LL.D., *James B. Duke Professor of Church History*
Olan Lee Petty (1952), Ph.D., *Professor of Education*
Leland R. Phelps (1961), Ph.D., *Professor of German*
Jane Philpott (1951), Ph.D., *Professor of Botany*
Orrin Pilkey (1965), Ph.D., *Associate Professor of Geology*
Theo Clyde Pilkington (1958), Ph.D., *Professor of Electrical Engineering and Professor of Biomedical Engineering*
Colin G. Pitt (1969), Ph.D., *Adjunct Associate Professor of Chemistry*
Robert A. Pittillo, Jr. (1968), Ed.D., *Associate Professor of Education*

[32] Sabbatical leave, fall semester, 1972.
[33] Sabbatical leave, academic year, 1972-73.
[34] Sabbatical leave, academic year, 1972-73.
[35] Sabbatical leave, academic year, 1972-73.
[36] Leave of absence, academic year, 1972-73.
[37] Sabbatical leave, academic year, 1972-73.
[38] Retired, August 31, 1972.
[39] Sabbatical leave, academic year, 1972-73.
[40] Retired, August 31, 1972.

[41] Jacques C. Poirier (1955), Ph.D., *Professor of Chemistry*
[42] Louis Pondy (1967), Ph.D., *Associate Professor of Business Administration and Assistant Professor of Sociology*
Ned Allen Porter (1969), Ph.D., *Assistant Professor of Chemistry*
Travis Porter (1972), J.D., *Adjunct Professor of Business Administration*
Herbert S. Posner (1968), Ph.D., *Clinical Associate Professor of Pharmacology*
William H. Poteat (1960), Ph.D., *Professor of Christianity and Culture*
Philip Pratt (1966), M.D., *Professor of Pathology*
Richard Lionel Predmore (1950), D.M.L., *Professor of Romance Languages*
[43] Jack J. Preiss (1959), Ph.D., *Professor of Sociology*
Richard A. Preston (1961), Ph.D., *William K. Boyd Professor of History*
James Ligon Price, Jr. (1952), Ph.D., *Professor of Religion*
Louis DuBose Quin (1956), Ph.D., *Professor of Chemistry*
Naomi Quinn (1972), Ph.D., *Assistant Professor of Anthropology*
K. V. Rajagopalan (1966), Ph.D., *Associate Professor of Biochemistry*
Charles William Ralston (1953), Ph.D., *Professor of Forest Soils*
Dietolf Ramm (1969), Ph.D., *Assistant Professor of Computer Science*
Dale B. J. Randall (1957), Ph.D., *Professor of English*
Norman B. Ratliff (1968), M.D., *Associate Professor of Pathology*
Michael Kay Reedy (1969), M.D., *Associate Professor of Anatomy*
Edmund Reiss (1967), Ph.D., *Professor of English*
Eugene M. Renkin (1963), Ph.D., *Professor of Physiology*
Jacqueline A. Reynolds (1969), Ph.D., *Assistant Professor of Anatomy and Associate Professor of Biochemistry*
David Claude Richardson (1969), Ph.D., *Assistant Professor of Biochemistry*
[44] Lawrence Richardson, Jr. (1966), Ph.D., *Professor of Latin in Classical Studies*
Eberhard Karl Riedel (1971), Ph.D., *Assistant Professor of Physics*
Kent J. Rigsby (1971), Harvard Society of Fellows, *Assistant Professor of Classics*
Nathan Russell Roberson (1963), Ph.D., *Associate Professor of Physics*
George W. Roberts (1971), Ph.D., *Associate Professor of Philosophy*
J. David Robertson (1966), M.D., Ph.D., *Professor of Anatomy*
Charles K. Robinson (1961), Ph.D., *Associate Professor of Religion*
George Robinson (1971), Ph.D., *Assistant Professor of Psychology*
[45] Hugh G. Robinson (1964), Ph.D., *Professor of Physics*

[41] Sabbatical leave, fall semester, 1972.
[42] Leave of absence, academic year, 1972-73.
[43] Sabbatical leave, spring semester, 1973.
[44] Sabbatical leave, academic year, 1972-73.
[45] Sabbatical leave, spring semester, 1973.

Hermann R. Robl (1959-64; 1966), Ph.D., *Adjunct Professor of Physics*
[46] Theodore Ropp (1938), Ph.D., *Professor of History*
Carl M. Rose, Jr. (1967), Ph.D., *Assistant Professor of Physics*
David Rosenthal (1969), Ph.D., *Adjunct Associate Professor of Chemistry*
Wendell F. Rosse (1966), M.D., *Associate Professor of Immunology*
[47] Donald Francis Roy (1950), Ph.D., *Professor of Sociology*
Clyde de Loache Ryals (1973), Ph.D., *Professor of English*
Harvey J. Sage (1964), Ph.D., *Associate Professor of Biochemistry and Assistant Professor of Pathology*
Herman Salinger (1955), Ph.D., *Professor of German*
Jay S. Salkin (1969), Ph.D., *Assistant Professor of Economics*
John V. Salzano (1956), Ph.D., *Associate Professor of Physiology*
[48] Charles Richard Sanders (1937), Ph.D., *Professor of English*
David H. Sanford (1970), Ph.D., *Associate Professor of Philosophy*
[49] Lloyd Saville (1946), Ph.D., *Professor of Economics*
Saul M. Schanberg (1967), M.D., Ph.D., *Associate Professor of Pharmacology*
Harold Schiffman (1963), Ph.D., *Professor of Psychology*
[50] Knut Schmidt-Nielsen (1952), Mag. Sc., Dr.Phil., *James B. Duke Professor of Physiology in the Department of Zoology*
Ernest Schoffeniels (1969), M.D., *Visiting Professor of Physiology and Pharmacology*
David W. Schomberg (1968), Ph.D., *Assistant Professor of Physiology*
James M. Schooler, Jr. (1970), Ph.D., *Assistant Professor of Physiology*
[51] Anne Firor Scott (1961), Ph.D., *Professor of History*
David W. Scott (1971), Ph.D., *Assistant Professor of Immunology*
[52] William E. Scott (1958), Ph.D., *Professor of History*
Richard A. Scoville (1961), Ph.D., *Associate Professor of Mathematics*
[53] Richard B. Searles (1965), Ph.D., *Associate Professor of Botany*
H. G. Seigler (1967), M.D., *Associate Professor of Immunology*
James Shafland (1969), Ph.D., *Assistant Professor of Anatomy*
Marion L. Shepard (1967), Ph.D., *Associate Professor of Mechanical Engineering*
Joseph R. Shoenfield (1952), Ph.D., *Professor of Mathematics*
William Derek Shows (1967), Ph.D., *Assistant Professor of Medical Psychology*
R. Baird Shuman (1962), Ph.D., *Professor of Education*
Lewis M. Siegel (1966), Ph.D., *Assistant Professor of Biochemistry*
Bernard Silberman (1967), Ph.D., *Professor of History*
Ida Simpson (1967), Ph.D., *Associate Professor of Sociology*
William H. Simpson (1930), Ph.D., *Professor of Political Science*
Theodore Alan Slotkin (1971), Ph.D., *Assistant Professor of Physiology*
D. Moody Smith (1965), Ph.D., *Professor of Religion*
David A. Smith (1962), Ph.D., *Associate Professor of Mathematics*
Donald S. Smith, II (1961), M.H.A., *Assistant Professor of Health Administration*
[54] Grover C. Smith (1952), Ph.D., *Professor of English*
Harmon Smith (1959), Ph.D., *Associate Professor of Moral Theology*
[55] Joel Smith (1958), Ph.D., *Professor of Sociology*
[56] Peter Smith (1959), Ph.D., *Professor of Chemistry*
Ralph Smith (1970), Ph.D., *Assistant Professor of Microbiology*
George G. Somjen (1963), M.D., *Professor of Physiology and Lecturer in Psychology*
Joachim R. Sommer (1957), M.D., *Associate Professor of Pathology*
[57] Joseph John Spengler (1934), Ph.D., *James B. Duke Professor of Economics*

[46] Leave of absence, academic year, 1972-73.
[47] Sabbatical leave, academic year, 1972-73.
[48] Sabbatical leave, academic year 1972-73.
[49] Sabbatical leave, academic year, 1972-73.
[50] Sabbatical leave, fall semester, 1972.
[51] Leave of absence, academic year, 1972-73.
[52] Sabbatical leave, academic year, 1972-73.
[53] Sabbatical leave, academic year, 1972-73.
[54] Sabbatical leave, academic year, 1972-73.
[55] Sabbatical leave, academic year, 1972-73
[56] Sabbatical leave, fall semester, 1972.
[57] Retired, August 31, 1972.

Bernard F. Spielvogel (1972), Ph.D., *Adjunct Associate Professor of Chemistry*
George Spooner (1965), Ph.D., *Assistant Professor of Pathology*
Thomas Arthur Spragens, Jr. (1967), Ph.D., *Assistant Professor of Political Science*
Olaf Stackelberg (1963), Ph.D., *Associate Professor of Mathematics*
John E. R. Staddon (1967), Ph.D., *Professor of Psychology*
William J. Stambaugh (1961), Ph.D., *Professor of Forest Pathology*
Dennis Keith Stanley (1961), Ph.D., *Associate Professor of Classical Studies*
Charles Franklin Starmer, Jr. (1966), Ph.D., *Associate Professor of Computer Science*
Howard Steinman (1970), Ph.D., *Associate in Biochemistry*
David Curtis Steinmetz (1971), Th.D., *Associate Professor of Religion*
Henry R. Sterr (1968), Ph.D., *Assistant Professor of German*
[58] Lionel Stevenson (1955), Ph.D., *James B. Duke Professor of English*
Philip Stewart (1972), Ph.D., *Associate Professor of Romance Languages*
Donald E. Stone (1963), Ph.D., *Professor of Botany*
Boyd R. Strain (1969), Ph.D., *Associate Professor of Botany*
[59] Victor H. Strandberg (1966), Ph.D., *Associate Professor of English*
Howard Austin Strobel (1948), Ph.D., *Professor of Chemistry*
Henry L. Sublett, Jr. (1962), Ed.D., *Associate Professor of Education*
J. Bolling Sullivan (1970), Ph.D., *Assistant Professor of Biochemistry*
Elizabeth Read Sunderland (1939-42; 1943), Ph.D., *Professor of Art*
John Sutherland (1969), Ph.D., *Assistant Professor of Zoology*

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[58] Retired, August 31, 1972.
[59] Sabbatical leave, academic year, 1972-73.

Louis E. Swanson (1949), A.B., *Associate Professor of Health Administration*
John Sykes (1968), Ph.D., *Assistant Professor of Physics*
Charles Tanford (1959), Ph.D., *James B. Duke Professor of Physical Biochemistry*
John J. TePaske (1967), Ph.D., *Professor of History*
Marcel Tetel (1960), Ph.D., *Professor of Romance Languages*
Larry W. Thompson (1961), Ph.D., *Lecturer in Psychology*
Fredrick L. Thurstone (1967), Ph.D., *Professor of Electrical Engineering and Professor of Biomedical Engineering*
Edward A. Tiryakian (1965), Ph.D., *Professor of Sociology*
Craig Tisher (1969), M.D., *Assistant Professor of Pathology*
Daniel C. Tosteson (1961), M.D., *James B. Duke Professor of Physiology*
Vladimir G. Treml (1967), Ph.D., *Professor of Economics*
Richard Trilling (1970), Ph.D., *Assistant Professor of Political Science*
James Nardin Truesdale (1930), Ph.D., *Professor of Greek*
Vance Tucker (1964), Ph.D., *Associate Professor of Zoology*
Arlin Turner (1953), Ph.D., *Professor of English*
Senol Utku (1970), Sc.D., *Professor of Civil Engineering*
Arturo Valenzuela (1970), Ph.D., *Assistant Professor of Political Science*
Thomas C. Vanaman (1970), Ph.D., *Assistant Professor of Microbiology*
John M. Vernon (1966), Ph.D., *Professor of Economics*
Aleksandar Sedmak Vesic (1964), D.Sc., *J. A. Jones Professor of Civil Engineering*
P. Aarne Vesilind (1970), Ph.D., *Assistant Professor of Civil Engineering*
Elia E. Villanueva (1961), M.A., *Assistant Professor of Physical Therapy*
Patrick R. Vincent (1954), Ph.D., *Associate Professor of Romance Languages*
F. Stephen Vogel (1961), M.D., *Professor of Pathology*
Steven Vogel (1966), Ph.D., *Associate Professor of Zoology*
Louis D. Volpp (1967), Ph.D., *Professor of Business Administration*
Fred M. Vukovich (1967), Ph.D., *Adjunct Associate Professor of Forest Meteorology*
Howard C. Wachtel (1968), Ph.D., *Associate Professor of Biomedical Engineering and Assistant Professor of Physiology*
Stephen A. Wainwright (1964), Ph.D., *Associate Professor of Zoology*
William D. Walker (1971), Ph.D., *Professor of Physics*
Richard L. Walter (1962), Ph.D., *Associate Professor of Physics*
Paul P. Wang (1968), Ph.D., *Associate Professor of Electrical Engineering*
Calvin L. Ward (1952), Ph.D., *Associate Professor of Zoology*
Frances Ellen Ward (1969), Ph.D., *Assistant Professor of Immunology*
Bruce W. Wardropper (1962), Ph.D., *William Hanes Wannamaker Professor of Romance Languages*
Seth L. Warner (1955), Ph.D., *Professor of Mathematics*
Richard Lyness Watson, Jr. (1939), Ph.D., *Professor of History*
Katharine Way (1968), Ph.D., *Adjunct Professor of Physics*
Robert E. Webster (1970), Ph.D., *Associate Professor of Biochemistry*
Eliot Weintraub (1970), Ph.D., *Associate Professor of Economics*
Morris Weisfeld (1967), Ph.D., *Professor of Mathematics*
Henry Weitz (1950), Ed.D., *Professor of Education*
[60] Richard L. Wells (1962), Ph.D., *Associate Professor of Chemistry*
Paul Welsh (1948), Ph.D., *Professor of Philosophy*
Robert W. Wheat (1956), Ph.D., *Associate Professor of Microbiology and Assistant Professor of Biochemistry*
Charles W. White (1970), Ph.D., *Assistant Professor of Psychology*
Richard A. White (1963), Ph.D., *Associate Professor of Botany*
[61] Karl Milton Wilbur (1946), Ph.D., *James B. Duke Professor of Zoology*
Robert L. Wilbur (1957), Ph.D., *Professor of Botany*
[62] Pelham Wilder, Jr. (1949), Ph.D., *Professor of Chemistry*
William E. Wilkinson (1967), Ph.D., *Assistant Professor of Mathematics*
Hilda Pope Willett (1948), Ph.D., *Professor of Microbiology*
George W. Williams (1957), Ph.D., *Professor of English*
Leland Williams (1970), Ph.D., *Adjunct Associate Professor of Computer Science*
William Hailey Willis (1963), Ph.D., *Professor of Greek in Classical Studies*

[60] Sabbatical leave, fall semester, 1972.
[61] Leave of absence, spring semester, 1973.
[62] Sabbatical leave, spring semester, 1973.

James F. Wilson (1967), Ph.D., *Associate Professor of Civil Engineering*
James W. Wilson (1967), M.D., Ph.D., *Assistant Professor of Pathology*
John Wilson (1968), Ph.D., *Associate Professor of Sociology*
Thomas George Wilson (1959), Sc.D., *Professor of Electrical Engineering*
Cliff W. Wing, Jr. (1965), Ph.D., *Associate Professor of Psychology*
Orval S. Wintermute (1958), Ph.D., *Associate Professor of Religion*
[63] Ronald Witt (1971), Ph.D., *Associate Professor of History*
Benjamin Wittels (1961), M.D., *Professor of Pathology*
Myron Wolbarsht (1969), Ph.D., *Professor of Biomedical Engineering, Associate Professor o Physiology, and Lecturer in Psychology*
Max A. Woodbury (1966), Ph.D., *Professor of Computer Science*
Donald Wright (1967), Ph.D., *Assistant Professor of Mechanical Engineering*
James E. Wuenscher (1970), Ph.D., *Assistant Professor of Forest Ecology*
David O. Yandle (1967), Ph.D., *Associate Professor of Forest Mathematics*
[64] William P. Yohe (1958), Ph.D., *Professor of Economics*
Charles R. Young (1954), Ph.D., *Professor of History*
[65] Franklin W. Young (1944-50; 1968), Ph.D., *Amos Ragan Kearns Professor of Ne Testament and Patristic Studies in Religion*
Hans J. Zweerink (1970), Ph.D., *Assistant Professor of Microbiology*

Emeritus Professors

Katharine May Banham (1946), Ph.D., *Professor Emeritus of Psychology*
Charles A. Baylis (1952), Ph.D., *Professor Emeritus of Philosophy*
Joseph W. Beard (1937), M.D., *James B. Duke Professor Emeritus of Virology*
Lucius Aurelius Bigelow (1929), Ph.D., *Professor Emeritus of Chemistry*
Edward Claude Bolmeier (1948), Ph.D., *Professor Emeritus of Education*
Benjamin Boyce (1950), Ph.D., *James B. Duke Professor Emeritus of English*
Benjamin Guy Childs (1924), M.A., *Professor Emeritus of Education*
Kenneth Willis Clark (1931), Ph.D., D.D., *Professor Emeritus of New Testament*
Frederick A. G. Cowper (1918), Ph.D., *Professor Emeritus of Romance Languages*
John S. Curtiss (1945), Ph.D., *James B. Duke Professor Emeritus of History*
Bingham Dai (1943), Ph.D., *Professor Emeritus of Psychology*
Neal Dow (1934), Ph.D., *Professor Emeritus of Romance Languages*
George Sharp Eadie (1930), Ph.D., *Professor Emeritus of Physiology and Pharmacology*
Howard Easley (1930), Ph.D., *Associate Professor Emeritus of Education*
William Whitfield Elliott (1925), Ph.D., *Professor Emeritus of Mathematics*
Allan H. Gilbert (1920), Ph.D., *Professor Emeritus of English*
Clarence Gohdes (1930), Ph.D., *James B. Duke Professor Emeritus of English*
Irving Emery Gray (1930), Ph.D., *Professor Emeritus of Zoology*
Paul M. Gross (1919), Ph.D., *William Howell Pegram Professor Emeritus of Chemistry*
Charles Cleveland Hatley (1917), Ph.D., *Professor Emeritus of Physics*
Duncan Charteris Hetherington (1930), M.D., Ph.D., *Professor Emeritus of Anatomy*
Calvin Bryce Hoover (1925), Ph.D., *James B. Duke Professor Emeritus of Economics*
Jay Broadus Hubbell (1927), Ph.D., *Professor Emeritus of English*
Wanda S. Hunter (1947), Ph.D., *Professor Emeritus of Zoology*
William H. Irving (1936), B.A. (Oxon.), Ph.D., *Professor Emeritus of English*
Brady Rimbey Jordan (1927), Ph.D., *Professor Emeritus of Romance Languages*
Helen L. Kaiser (1943), R.P.T., *Professor Emeritus of Physical Therapy*
William Thomas Laprade (1909), Ph.D., *Professor Emeritus of History*
Charles Earl Landon (1926), Ph.D., *Professor Emeritus of Economics*
Alan Krebs Manchester (1929), Ph.D., *Professor Emeritus of History*
Ernest William Nelson (1926), Ph.D., *Professor Emeritus of History*
Walter McKinley Nielsen (1925), Ph.D., *James B. Duke Professor Emeritus of Physics*
James G. Osborne (1961), B.S., *Professor Emeritus of Forestry*
Robert Leet Patterson (1945), Ph.D., *Professor Emeritus of Philosophy*
Harold Sanford Perry (1932), Ph.D., *Professor Emeritus of Botany*
Robert Stanley Rankin (1927), Ph.D., *Professor Emeritus of Political Science*
Mabel F. Rudisill (1948), Ph.D., *Professor Emeritus of Education*

[63] Leave of absence, spring semester, 1973.
[64] Sabbatical leave, fall semester, 1972.
[65] Sabbatical leave, fall semester, 1972.

David Tillerson Smith (1930), M.D., Litt.D., *James B. Duke Professor Emeritus of Microbiology*
H. Shelton Smith (1931), Ph.D., *James B. Duke Professor Emeritus of Religion*
Hersey Everett Spence (1918), *Professor Emeritus of Religious Education*
William Franklin Stinespring (1936), Ph.D., *Professor Emeritus of Old Testament and Semitics*
W. A. Stumpf (1948), Ph.D., *Professor Emeritus of Education*
Edgar Tristram Thompson (1935), Ph.D., *Professor Emeritus of Sociology*
Clement Vollmer (1926), Ph.D., *Professor Emeritus of German*
Warren Chase Vosburgh (1928), Ph.D., *Professor Emeritus of Chemistry*
Loring Baker Walton (1929), Lic. es L., Ph.D., *Professor Emeritus of Romance Languages*
Charles Eugene Ward (1927), Ph.D., *Professor Emeritus of English*
Robert Renbert Wilson (1925), Ph.D., LL.D., *James B. Duke Professor Emeritus of Political Science*
Frederick Adolphus Wolf (1927), Ph.D., *James B. Duke Professor Emeritus of Botany*
Robert Hilliard Woody (1929), Ph.D., *Professor Emeritus of History*

To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

> The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.
>
> Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.

John C. McKinney

John C. McKinney
Dean of the Graduate School

1

Program Information

Degrees Offered

The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Hospital Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.).

The Master's Degrees

To be considered as a candidate for a master's degree (A.M., M.S., M.Ed., M.A.T., M.H.A., M.B.A.), the graduate student must (1) have made passing grades in the first 12 units of course work, (2) have made a grade of *G* or *E* on at least 3 units of this work, and (3) have received the approval of the major department (or in the case of the M.A.T., of the supervisory committee).

Residence Requirements. Candidates for all master's degrees must spend, as a *minimum,* one full academic year, or its equivalent in summer session terms, in residence at Duke University. Those who wish to complete their degrees wholly in the summer session must be in residence for five terms. *Three terms are held each summer.* Depending upon the degree program pursued and the individual student himself, additional time frequently proves necessary. (See section on Residence under Academic Regulations.)

Transfer of Graduate Credits. Under certain circumstances a maximum credit of 6 units may be allowed for graduate courses completed elsewhere. Units from other institutions will be transferred only if the student has received for them a grade of *B* (or its equivalent) or better. *In any case, the transfer of graduate credit does not reduce the required minimum registration for a master's degree* *at Duke.* In planning a master's program, a student who wishes to transfer up to 6 units into his program must, nevertheless, register at Duke for units equivalent to the number he is transferring.

With the approval of both the student's major department and the Dean of the Graduate School, a student who is granted such transfer credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units, or he may be permitted to fill out his schedule with as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level. In no case will credit be allowed for extension or correspondence courses.

Credit for graduate courses taken at Duke by a student (not undergraduate or non-degree) before his admission to the Graduate School may be carried over into a graduate degree program if: (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of *G* level or better.

Time Limits for Completion of Master's Degrees. The master's degree candidate who is in residence for consecutive academic years should complete all requirements for the degree *within two calendar years* from the date of his first registration in the Graduate School. Any candidate must complete all requirements *within six calendar years of his first registration.*

To be awarded a degree in May, the student must have completed all requirements, including the recording of transfer credit, by the last day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School Office by April 15. Candidates desiring to have their degrees conferred on September 1 must have completed all requirements as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 1.)

The Thesis. The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on his special research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the Duke University *Guide for the Preparation of Theses and Dissertations.*

MASTER OF ARTS

The Master of Arts degree may be earned either with or without presentation of a thesis. Whether or not a student writes a thesis, however, certain general requirements must be met. If the master's degree requirements are not specified in the departmental heading of this *Bulletin*, a prospective student should write directly to the appropriate director of graduate studies.

Prerequisites. As prerequisites to graduate study in his major subject, the student must have completed a *minimum* of 24 semester hours—normally 12 semester hours of approved college courses in that subject and 12 additional semester hours in that subject or in related work. Since some departments require more than 12 semester hours, the student should read carefully the special requirements listed by his major department, which are included as headnotes to the course offerings in this *Bulletin*.

Language Requirements. The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have a foreign language requirement for their master's program. Any such requirement must be satisfied before the master's examination is taken. (See the appropriate section in the Chapter on Registration and Regulations.)

Major and Related Subjects. In his graduate work the student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the major subject. A minimum of 6 units must be in a minor subject or related fields which are approved by his major department. The remaining 6 units of the required 24 may be taken in either the major or in related fields approved by the major department and by the Dean of the Graduate School. The nature of the additional 6 units for which he must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the student's department. (See below.) Earned credit for the degree totals a *minimum* of 30 units.

Completing the Program with Thesis. All basic requirements for preparing the thesis are described in the *Guide for the Preparation of Theses and Dissertations,* available in the Graduate School Office.

Four typewritten copies of the thesis bound in snap binders secured through the Graduate School Office must be submitted in an approved form to the Dean of the Graduate School on or before April 15 for a May degree, or August 15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Two copies for the library and one for the adviser will be bound by the Ruzicka Bindery, upon payment of a fee of $5.00 per volume. The student should state whether or not he wishes more than three copies so bound.

Completing the Program without Thesis. The options with which a Master of Arts degree may be completed without presentation of a thesis are determined by the individual departments. Normally a student's committee makes its decision on his degree program after he has completed at least 9 units of graded course work. Beyond the 24 units required in major or related course work, 6 units may be earned either with additional course work or with other equivalent academic exercises approved by the student's department and committee. Such academic exercises might include an additional 3 units of graded course work supplemented, for example, by the following: (1) passing an oral examination on a three- to five-page research prospectus, plus a substantial bibliography on a topic within the student's major field, or (2) successful submission to the committee of two carefully revised term papers, preferably written originally for different instructors and originally earning a grade of *G* or higher. In any case, the student's total minimum registration will be for 30 units of work, followed by a final examination (see below).

The Examining Committee and the Examination. The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted tc take related work within the major department, the third member may be choser from within the department. Nominations for membership on this committee arc submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The student's committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. If a thesis is presented, the committee also signs all copies of the thesis, and the candidate then returns the original, the first two copies, and any other copies he wishes bound by Ruzicka, to the Dean of the Graduate School, who has them deposited in the University Library.

Filing the Intention to Graduate. On or *before February 1 for a May degree* or on or *before August 1 for a September degree,* the student must file in the Office of the Graduate School, on the official form, a declaration of intention to graduate. If degree requirements have been met before the deadlines above, the intention to graduate must be filed one month before the final examination. The declaration of intention gives the title of the thesis or specifies the alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of the director of graduate studies in the major department, and of the student's committee chairman.

MASTER OF SCIENCE

The degree of Master of Science is offered in the four fields of engineering—biomedical, civil, electrical, and mechanical—in forestry, in management science, in physical therapy, and in statistics and computing.

Engineering Prerequisites. As prerequisites to this degree, the student must have earned a bachelor's degree from an accredited engineering college and have completed a minimum of 12 semester hours of work in the major field.

Forestry Prerequisite. As a prerequisite to this degree, the student must have earned a bachelor's degree which includes an undergraduate program in forestry or an allied field.

Management Science Prerequisite. Graduates from any discipline are eligible for admission since the only specific course prerequisite is one year of calculus. Applicants from the physical and biological sciences, mathematics, engineering, and economics are normally well suited for the program.

Physical Therapy Prerequisites. As prerequisites to this degree, the student must have earned a bachelor's degree and completed the following course work: a minimum of 30 semester hours of laboratory courses in the natural sciences with a minimum of one academic year of biology, chemistry, and physics; 15 semester hours in the social sciences, 6 of which must be in psychology; and at least 6 semester hours of mathematics. Introductory courses in statistics and biochemistry are recommended.

Statistics and Computing Prerequisites. As prerequisites to this degree, the student must have earned a bachelor's degree with a strong mathematics background including 3 semester hours of linear algebra and 6 semester hours of probability and statistics. The student must also have experience in computer programming with competence in at least one algorithmic language.

Language Requirement. There is no foreign language requirement for students in the Master of Science degree program.

Engineering Program. The work of the Master of Science degree is designed to provide a broad foundation in the fields of biomedical, civil, electrical, and mechanical engineering. The student must present acceptable grades for a minimum of 24 units of graduate courses: at least 12 units in course work in his major area of concentration in engineering (not necessarily confined to the offerings of the engineering department in which the student is registered); a minimum of 6 units in a minor subject outside of engineering which lends broad support to his program (usually in mathematics or natural sciences); and the remaining 6 of the 24-unit course requirement in either the major or minor subject, or in an area approved by the major department. The nature of the additional 6 units for which the student must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the student's department. His earned credit for the degree totals a minimum of 30 units.

Forestry Program. The work for the Master of Science degree is designed to provide a basic foundation in a fundamental area of forestry or in a field closely allied with forestry. A minimum of 30 units of credit is required for the degree, of which 24 units must be in formal course work. Specific course requirements call for a minimum of 12 units in a major field of specialization and 6 units in a minor area of concentration. The major and minor fields are determined without regard to departmental divisions of the University if the interdisciplinary nature of the area of specialization makes such a program of

study advisable. The specific program of study is developed by the major professor (thesis supervisor) subject to the approval of the Director of Graduate Studies in Forestry and the Dean of the Graduate School.

Management Science Program. The Master of Science in Management program is an evening program for individuals who hold full-time positions and who desire graduate-professional preparation for the management of complex organizations. Forty units of course work are required in a prescribed sequence of 8 units in five consecutive semesters, including the summer. The fifth semester is devoted to an applied, functional area elected by the student, and to the practicum as a major application of the foundations and tools of completed courses to a significant problem of a complex organization.

A major purpose of the program is to teach the foundations, concepts, and structures useful in the analysis and design of plans and operations of an economic enterprise. The common form of problems within the several segments of the organization and the interrelationships among solutions to problems are emphasized. Such emphasis enhances the manager's capacity to identify the essential variables in a problem and to distinguish between the common form among problems and the uniqueness in any specific case. The resulting flexibility should increase mobility across functions and should help develop the perspective needed to coordinate several unlike functions.

Another purpose of the program is to teach modern tools of analysis so that problems of complex organizations can be understood and solved. Just as important, the tools of analysis should help the manager to continue his own learning. The background needed to learn the most useful additions to the management literature includes both foundational concepts and the modern tools of analysis. This background, as compared with that built in a descriptively oriented program, improves the manager's ability to learn from events in his environment and to do so in an integrated, orderly manner.

Physical Therapy Program. The work for the Master of Science degree is designed to provide a broad foundation in the art and science of physical therapy and opportunities for the development of skills in administration and supervision, experience in curriculum development and directed teaching in physical therapy, and advanced clinical education or research experience. The program of study includes a minimum of 52 units of graduate credit, of which 30 to 32 are in courses in physical therapy, 12 are in designated courses in anatomy and physiology, and 9 are in elective courses. Completion of the prescribed curriculum requires four semesters and one summer of full-time work in order to meet the academic and clinical experience requirements of the program.

Statistics and Computing Program. The Master of Science in Statistics and Computing is a program offered by the Department of Mathematics which requires the student to blend course work in statistical theory with practical experience in analyzing real world data on the computer. Twenty-four units of course work are required including Mathematics 260, 262, 284, 293; and Computer Science 152, 221, and 223. The remaining 6 units are earned by completing a thesis project involving an application of statistics which utilizes the computer.

Thesis and Examination. The regulations and options for completing the program and the provisions for examination and an examining committee are the same as those for the Master of Arts degree discussed in the previous section.

However, the Department of Forestry requires a thesis for completion of the M.S. degree.

MASTER OF EDUCATION

Prerequisites. Before a student is admitted to graduate study for this degree, he should have completed, on the undergraduate level, a minimum of 18 semester hours of approved work in education.

Before the degree is conferred the student must have had one year of actual teaching experience, or have met certification requirements by doing supervised student teaching in an accredited school. Such supervised student teaching may be at either the undergraduate or the graduate level.

Completing the Program without the Thesis. The required work includes a departmental major (administration, counseling, elementary education, secondary education, reading, or teaching the emotionally disturbed) of at least 12 units, and a minor of at least 6 units outside the Department of Education. The remaining 12 units are elective within the area of education and the minor field, but require the approval of the student's major adviser and the Director of Graduate Studies.

Toward the end of his residence the student must pass a comprehensive examination on his departmental major. This examination shall be prepared and conducted by the instructors of the student's major as designated by the Director of Graduate Studies of the Department of Education. A request to take this examination should be made to the Director of Graduate Studies at least two weeks before the date on which the examination is to be conducted.

Completing the Program with the Thesis. Students who elect this plan are permitted to substitute a thesis for 6 units of the required course work. The thesis subject must be approved by the instructor who is to direct it and by the Director of Graduate Studies.

In addition to the thesis, the student must present at least 24 units of course credit. Of these, 12 units must be taken in the student's departmental major. Six units, constituting a minor, must be taken outside of the Department of Education. The remaining 6 units are elective within the area of education and the minor field, but require the approval of the student's major adviser and the Director of Graduate Studies.

The regulations governing the thesis are the same as those for the Master of Arts degree.

Recommendation for Teacher Certification. Elementary school teachers who already hold certificates and who desire the recommendation of Duke University for a graduate teaching certificate must include in their master's program a minimum of 12 units in subjects ordinarily taught in elementary school and 12 units in education courses designed to improve them as elementary school teachers.

MASTER OF ARTS IN TEACHING

Prerequisites. The degree of Master of Arts in Teaching is designed for teachers already in service and for recent graduates of liberal arts colleges who wish to teach in a public school, private school, or junior college.

A student should normally have completed a minimum of 12 semester hours in his proposed major subject and an additional 12 semester hours in that or related subjects. Should a student wish to undertake a graduate major different from his undergraduate major, the prerequisites may be modified upon the recommendation of the student's committee and the approval of the Dean of the Graduate School.

Degree Programs. Either of two programs may be arranged, in consultation with the student's committee.

1. A major in education of 18 to 24 units and 12 to 18 units in non-education courses (for students seeking certification): a total of 36 units.

2. A major in non-education courses of 18 to 24 units and 6 to 12 units in education (for students already certified): a total of 30 units.

The non-education courses are to be taken in one or more subjects ordinarily taught in the secondary schools. The amount and distribution of this work will be determined by the needs of the individual student. A combined major in biological sciences or in physical sciences is possible in this program. Teachers who have already completed certification requirements must major in a teaching field in their Master of Arts in Teaching program. Students who have not completed certification requirements must major in education.

The Master of Arts in Teaching may be earned with or without the presentation of a thesis. If a student, in consultation with his committee, elects to present a thesis, 6 units of the total of 30 units required will be allotted to thesis research. He will then be required to complete 24 units of course credits. The regulations governing the thesis are the same as those for the A.M. degree *with thesis*. Candidates for the Master of Arts in Teaching degree who have not had teaching experience are required to take Education 216 and either 215 or 315, in which case a minimum of 36 units is required.

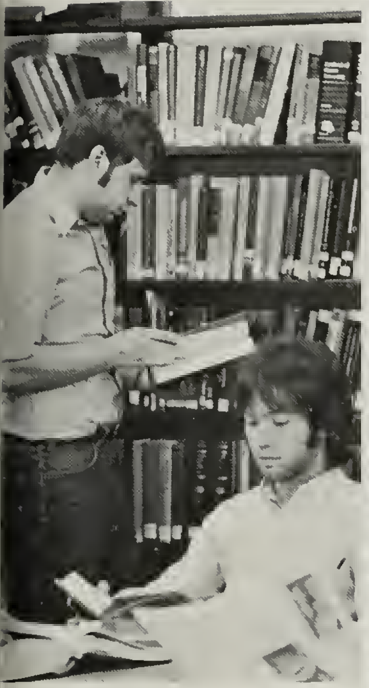
The Committee. Each candidate for the degree will be assigned a committee, appointed by the director of graduate studies in the major department or area. This committee will consist of three members, at least one of whom will be from the Department of Education, and at least one from another department. The chairman of the committee will normally be chosen from the department of the major.

Recommendation for Teacher Certification. Secondary school teachers who already hold certificates and desire the recommendation of Duke University for graduate teaching certificates must include in their master's program a minimum of 18 units in their teaching fields and 6 units in courses in education designed to improve them as secondary-school teachers.

MASTER OF HOSPITAL ADMINISTRATION

Beginning with the class entering in 1973, the newly reorganized Department of Health Administration will offer a completely revised curriculum for graduate students interested in the field of health services management. It is designed primarily for those who seek ultimately to assume major leadership roles in all types of organizations and programs that involve the provision of health services, whether in public or private settings.

The basic Master of Hospital Administration program is designed around a core of courses in health services and the management sciences, with electives in the behavioral sciences. The student also selects one of four concentrations for in-depth study: finance, personnel, planning, or information management. The academic portion, which includes a rotating practicum, is five continuous semesters



length. Upon completing the academic portion of the curriculum, the student akes a 12-month individually tailored rotating residency during which he re-eives a stipend. (Students with prior experience may petition for a waiver of he residency requirement.)

Students with any undergraduate major may apply. One year of calculus t the college level is the only prerequisite, and a special course at the University available each summer for students whose preparation in mathematics is arely adequate or somewhat out of date.

ASTER OF BUSINESS ADMINISTRATION

Prerequisites. The M.B.A. program is designed for students whose under-raduate work included at least one year of calculus and an educational back-round adequate to enable rigorous analysis. Normally, undergraduate majors in uch fields as the physical and biological sciences, mathematics, engineering, and he social sciences are well suited for the program. The M.B.A. program is de-igned to provide a thorough foundation in the concepts and theory that underlie he design, operation, and control of modern complex organizations.

Degree Program. The M.B.A. program contains a prescribed core of ourses dealing with tools of analysis and the fundamental theoretical foundations or demanding administrative practice. In addition, each candidate elects a set of ourses to prepare more specifically for his chosen professional practice.

The M.B.A. requires four semesters of full-time work totaling 64 uni of graduate course credit. (See the Business Administration section under Cours of Instruction for a more detailed description of the degree requirements.) T M.B.A. program has neither a language nor a thesis requirement. No form minor subject is required. A project in administrative research and formal writi is required in the fourth semester, and is described in the list of courses as t practicum.

The Doctor's Degrees

DOCTOR OF PHILOSOPHY

The Ph.D. degree is essentially a research degree. Although course wo is a necessary part of the student's program, the mere accumulation of cour credits will not be sufficient for attaining this degree. The granting of the Ph.D. based primarily upon the student's knowledge of a specialized field of study a upon the production of an acceptable dissertation embodying the results of origin research.

Requirements. The formal requirements for the Ph.D. degree are as follow (1) major or related courses, (2) foreign language(s) in most departments, (supervisory committee for program of study, (4) residence, (5) preliminary e amination, (6) dissertation, and (7) final examination. In order to be consider for candidacy for the Ph.D. degree, the student must have passing grades in of his course work, and on at least 9 units of this course work he must ha made a grade of *G* or better.

Foreign Languages. A reading knowledge of one foreign language, ancie or modern, is required by the Graduate School in almost all departments. In few departments, however, a language is not required. In others, a particul language is specified, and in still others more than one language may be require If the language requirement is not specified in the departmental heading of t *Bulletin*, a prospective student should inquire directly from the appropria director of graduate studies. (For methods of meeting the requirement, s Language Requirements.)

A student working toward the doctoral degree should complete the langua requirement for that degree by the end of his first year of residence. If he fails meet the requirement by the end of his third semester of residence, he must regist in the appropriate special reading course or courses until he has satisfied t requirement.

The foreign language requirement must be met before preliminary exa inations are taken.

Major and Related Work. The student's program of study necessarily d mands substantial concentration on courses in his major department. It may, ho ever, include a minimum of 6 units in a related field approved by his major depar ment. Use of related fields within the major department requires the authorizati of the Dean of the Graduate School and the Executive Committee of the Gradua Faculty.

Committee to Supervise the Program of Study. As early in a studen course of study as is practicable and *not later than two months before the pr liminary examination* the director of graduate studies in the major departme ill nominate for the approval of the Dean a supervising committee of five, with ie member designated as chairman. This committee will include at least three aduate faculty members of the major department and at least one from outside ie department. With authorization of the Dean and the Executive Committee of e Graduate Faculty, related work may be taken in a clearly differentiated di- sion within the department. The committee will draw up a program of study id administer the preliminary examination and, with such necessary changes as e approved by the Dean, the final doctoral examination. The final examination ay be administered with a minimum of four members, one of whom must present a field other than the major.

Residence. The *minimum* registration requirement is 60 units of graduate edit, of which not more than 30 units may be accepted by transfer. Since a full ogram is 30 units per academic year, the prospective Ph.D. candidate who enters ith the A.B. or B.S. degree must plan to spend in residence a *minimum* of two ademic years; if he enters with the A.M. degree, his *minimum* residence is one ademic year. (For the definition of *residence*, see the section on residence in the iapter on Academic Regulations.) If there are undergraduate deficiencies in his ogram, he may in addition to the minimum requirements be required to take eliminary undergraduate courses for which he will not receive graduate credit. ven if there are no such undergraduate deficiencies, the student's supervisory ommittee will determine what requirements, if any, above the minimum the udent must meet.

Credit for Summer Work. Credit earned in the summer session will not duce the minimum required residence (see section on the summer session).

Time Limitations. At the time that the preliminary examination is passed iy courses, language certifications, or other credits for advanced standing hich are more than six calendar years old will not be accepted toward fulfilling ie minimum requirements of the doctoral degree.

The student should normally pass the preliminary examination by the id of his third year of graduate study. If he has not passed it by the end of ie third year of full-time registration, he must file with the Dean of the raduate School a statement, approved by the director of graduate studies in is major department, explaining the delay and setting a date for the exami- ation. Except under unusual circumstances, extension will not be granted eyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two ilendar years after the preliminary examination is passed. Should the disserta- on not be submitted and accepted within four years after the examination, the indidate, with the approval of his committee, may petition the Dean of the raduate School for an extension of one year. Should this extension be granted nd the dissertation not be submitted and accepted within the year, the student iust pass a second preliminary examination to remain a candidate for the egree. In such a case, the time limit for submitting the dissertation will be etermined by the Dean of the Graduate School and the candidate's committee.

In exceptional cases of particular merit, however, and with the approval f the Dean of the Graduate School, the several departments may extend the mits of the total elapsed time within which credit will be allowed for courses, ie language examinations, and the preliminary examination. The graduate iculty of the departments will have these limits in mind when a student is eing considered for admission or readmission to the Ph.D. program, for approval to take the preliminary examination, and for approval to submit tl dissertation and take the final examination. In instances of excessive elaps time, revalidation of credits may be required. The responsibility for requiring suc revalidation will normally lie with the department, but the Dean's approval w be necessary.

Preliminary Examination. A student is not accepted as a candidate for tl Ph.D. degree until he has passed the preliminary examination. A transfer stude who may have passed a preliminary examination elsewhere must neverthele take the examination at the Duke Graduate School. The examination ordinari covers both the major field and related work. In the summer, a prelimina examination may be scheduled only between the opening and closing dates the summer session.

Privilege of Re-Examination. Should the student fail the preliminary e amination, he may apply, with the consent of his supervisory committee and the Dean of the Graduate School, for the privilege of a second examination to l taken no sooner than three months after the date of the first. Failure on tl second examination will render the student ineligible to continue his program f the Ph.D. degree at Duke University.

Reduction in Registration. Because the student who passes the prelimina examination is eligible for a reduction in required registration, he should assun responsibility for arranging in person with the Graduate School Office the chang in registration he desires.

The Dissertation. The dissertation is expected to be a mature and con petent piece of writing, embodying the results of significant and original researc

One month before the dissertation is presented and not later than Februa 1 (February 2 if February 1 falls on Sunday) preceding the May commenceme at which the degree is expected to be conferred, the student must file with tl Dean of the Graduate School, on the official form to be obtained from tl Graduate School Office, the title of the dissertation. This title must receive tl written approval of both the director of graduate studies of the student's maj department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation such as type paper, form, and binding are prescribed in the *Guide for the Preparation* *Theses and Dissertations* which is available in the Graduate School Office.

The dissertation must be completed to the satisfaction of the professor wh directs it. Four typewritten copies bound in snap binders secured through tl Graduate School Office must be deposited with the Dean of the Graduate Scho on or before *April 1* preceding the May commencement when the degree is to l conferred. The dissertation must be submitted to the Graduate School Office least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through Universi Microfilms, Ann Arbor, Michigan. Authors may also copyright them, if the wish. Abstracts are published in *Dissertation Abstracts International*.

In brief, all copies of the dissertation, the original in clean type, will remain spring binders until after the final examination. Three extra copies of the abstrac carefully written and not more than 600 words long, are submitted when tl dissertation is first presented to the Graduate School Office. A nonreturnable fe of $25.00 is charged for microfilming. If copyright is desired, an additional fe of $15.00 is charged. The original and two copies will be bound by the Ruzick indery at a cost of $5.00 per volume. The student may request that more than ree copies be so bound. If more than one snap binder is required per copy of e dissertation, a deposit of $3.50 will be collected for each additional snap inder.

Final Examination. The final oral examination shall be primarily on the issertation. Questions may, however, be asked in the candidate's major field. xcept in unusual circumstances approved by the Dean a final examination will ot be scheduled when school is not in session.

If a student fails his final examination, he may be allowed to take it a econd time, but not sooner than six months from the date of his first examination. ermission to take the second examination must be obtained from the professor ho directed the dissertation and from the Dean of the Graduate School. Failure pass the second examination renders the student ineligible to continue work r the Ph.D. degree at Duke University.

Deposit of the Dissertation. After passing the examination, the candidate rings to the Graduate School Office the original and the first two copies f the dissertation, properly signed, and any other copies he wishes to be bound. t this time he signs the microfilming agreement and pays the microfilming and opyright fees which are due.

OCTOR OF EDUCATION

The Doctor of Education degree is a professional degree planned for those ho are, or intend to become, school administrators, supervisors, directors of struction, curriculum consultants, counselors, college teachers of education, or ther professional personnel in the field of education. (The Doctor of Philosophy egree is offered in the above areas as well as in Comparative Education, History f Education, Philosophy of Education, and Law and Education.) The following rogram options are available to the student, subject to the approval of his octoral committee:

1. A doctoral project consisting of three major research papers judged by the committee to be of publishable quality. The student electing this option shall include in the program of study a minimum of 60 units of course work.
2. A major project or model (for example: a film, curriculum guides, instructional materials, in-service education plans for a school system, computer programs). The student electing this option shall include in the program of study a minimum of 60 units of credit of which at least 48 units shall be in course work. The remainder of the program may be made up of project research credit.
3. A dissertation embodying the results of significant research. The student electing this option shall include in the program of study a minimum of 60 units of credit of which at least 48 units shall be in course work. The remainder of the program may be made up of dissertation research credit. (The requirements governing the dissertation are the same as those for the Ph.D. degree.)

Requirements. The formal requirements for all options of the Ed.D. degree e as follows: (1) major and related courses, (2) supervisory committee for rogram of study, (3) registration, (4) professional experience, (5) preliminary examination, and (6) final examination. In order to be considered for continu enrollment, the student must have made a grade of *G* or better on at least units of the first 24 units of course work at Duke University.

Major or Related Work. The student's program of study necessarily demar substantial concentration on courses in his major department. It must, howev include a minimum of 12 units in related fields approved by his major departme

Foreign Languages. There are no foreign language requirements for t Ed.D. degree.

Program of Work. The candidate for the Ed.D. degree will choose as major field (*a*) educational administration and supervision, (*b*) counseling, (curriculum and instruction, or (*d*) education of emotionally disturbed childr

In all cases candidates will take a minimum of 36 units in the major a related areas and a minimum of 12 units in one or more minor areas.

Committee to Supervise the Program of Study. At the time of his enro- ment in the Ed.D. program, the student will be assigned a temporary adviser. Up the student's completion of 15 units of work toward the degree, the Director Graduate Studies will nominate for the approval of the Dean a supervising co- mittee of five, with one member designated as chairman. This committee w include at least three graduate faculty members from the major department a one from the minor. The committee will draw up a program of study and minister the preliminary examination and, with such necessary changes as approved by the Dean, the final doctoral examination. The final examination m be administered with a minimum of four members, one of whom must repres the minor.

Residence. The minimum registration requirement is 60 units of gradu credit, of which not more than 30 units may be accepted by transfer. (Trans credits which are more than six calendar years old at the time that the prelimina examination is passed will not be accepted.) No absolute time limit exists completing the requirements for the Ed.D. degree provided that the student continuously engaged in an approved position in education or is in full-ti residence. Every student shall be registered for a minimum of 6 units of wo during each twelve-month period from the time of first enrollment until work the degree has been completed.

Experience. Prior to receiving the Ed.D. degree, the student must ha completed a minimum of two years of employment in professional education.

The program of study must include a minimum of 6 units in practicu internship, and/or field experience under the direction of one or more appropri faculty members.

Preliminary Examination. A student is not accepted as a candidate for Ed.D. degree until he has passed the preliminary examination. The examinati is taken during or shortly after the term in which the approved program of cou work is completed. It may be oral or, if such a plan is approved by four of members of the student's doctoral committee including the chairman, the amination may be written. The written examination may be followed by an o examination upon the recommendation of any member of the doctoral committ

Should the student fail the preliminary examination, he may apply, w the consent of his supervisory committee and the Dean of the Graduate Scho or the privilege of a second examination to be taken no sooner than three months fter the date of the first. Failure on the second examination will render the tudent ineligible to continue his program for the Ed.D. degree at Duke University.

Final Examination. The final oral examination is based primarily on the esearch papers (option 1), project (option 2), or dissertation (option 3). Quesions may, however, be asked in the candidate's major field. Except in unusual ircumstances approved by the Dean, a final examination will be scheduled only vhen school is in session.

If a student fails his final examination, he may be allowed to take it for a econd time, but not sooner than six months from the date of his first. Perission to take the second examination must be obtained from the professor who irected the dissertation and from the Dean of the Graduate School. Failure to ass the second examination renders the student ineligible to continue work for the Ed.D. degree at Duke University.

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Special and Cooperative Programs

Center for the Study of Aging and Human Development

The primary aims of the Center have been to encourage and support fundamental research concerned with the processes and health problems of aging; to train investigators for research in the problems of aging; and to develop a source of scientific knowledge in the field of aging for state and local government as well as for private groups and individuals.

The Center conducts a two-year program for predoctoral or postdoctoral fellows who desire to pursue research training in some aspect of the behavioral sciences and psychophysiology in aging and human development. Through faculty seminars and independent work, fellows are enabled to focus on a chosen aspect of the life spectrum. Methodology and acquisition of specialized skills are stressed in addition to involvement in individual research. Under this program, continuation of research training support for a third year is possible. Resources available include the Psychophysiology Laboratory, research programs in behavioral medicine, child psychiatry, and geriatrics, as well as staff and facilities in anatomy, biochemistry, economics, endocrinology, obstetrics and gynecology, physiology, preventive medicine, psychiatry, and sociology, among others. Inquiries should be addressed to the Training Director, Center for the Study of Aging and Human Development, Duke University, Durham, North Carolina 27710.

Biomedical Engineering Program

The Graduate School offers an interdisciplinary program in biomedical engineering leading to the M.S. and Ph.D. degrees. The purpose of this program is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering.

The major research areas available include: biomechanics, biomedic materials, biomedical modeling, data acquisition and processing, and neural ne works. Information about graduate fellowships may be obtained from Dr. Frederic L. Thurstone, Director of Graduate Studies, Department of Biomedical Engi neering.

Center for Commonwealth Studies

The Center for Commonwealth Studies was established at Duke Universit in 1955 and has received financial support from the Carnegie Corporation of Ne York, the Rockefeller Foundation, and the Ford Foundation. Its objectives are:

1. To encourage and stimulate by financial assistance and other means th research interests of individual scholars in Commonwealth affairs, European institutions and their expansion, and development studies, and
2. To establish at Duke University a center whose facilities will promote interest in research relating to the Commonwealth, provide the materials for basic research, and encourage research by Commonwealth an American students and faculty.

The Center awards fellowships to graduate students from Australia, Canada and New Zealand who propose to study toward the Ph.D. degree in economics, history, or political science at Duke University. National selection committees in each of the above mentioned countries facilitate the selection of fellows.

Each spring the Center sponsors a joint seminar for graduate students in economics, history, and political science. The objective of this seminar is to encourage a broad approach to developments within the Commonwealth. In addition, the Center sponsors occasional lectures at the University by distinguished Commonwealth scholars.

Financial assistance is provided to students and faculty at the University for field research in Commonwealth countries. Studies resulting from research sponsored by the Center are frequently published by the Duke University Press in the Commonwealth Study Series, now numbering forty volumes. The Center also distributes in its reprint series selected published articles that relate to the Commonwealth. Inquiries should be addressed to the Director, Center for Commonwealth Studies, Commonwealth House, Duke University, Durham, North Carolina 27706.

Program in Comparative Studies on Southern Asia

The Program in Comparative Studies on Southern Asia was established a Duke University in 1961 following a grant from the Ford Foundation to th Center for Commonwealth Studies to enable it to develop a research and trainin program in that area. In 1963 the University entered into a contract with th United States Office of Education and sponsored a South Asian Language Training and Area Center under the provisions of Title VI of the National Defens Act. The basic purpose of this program is twofold: to facilitate research on th political, historical, economic, and sociocultural development of Commonwealt countries in Southern Asia (India, Pakistan, Ceylon, Malaysia, and Singapore) and to provide for the systematic training of graduate students in anthropology, economics, education, history, political science, religion, and sociology, wit special emphasis on the area.

The graduate student, in addition to meeting the requirements of the de- artment in which he is enrolled, is expected to take Hindi-Urdu or another major outh Asian language, the cognate courses in other departments, and to undertake eld research in the preparation of his dissertation.

The program awards each year a limited number of predoctoral fellowships nder the conditions specified above. Awards carrying the same expectations are so made under the NDEA Title VI language fellowships offered by the United tates Office of Education.

Facilitation and support of research activities by members of the Duke niversity faculty and graduate students are important aspects of the program's ctivities. Research grants for faculty and students are also available from the merican Institute of Indian Studies and the United States Office of Education. esearch facilities include those materials received as a result of the University's articipation in a library acquisitions program under the terms of Public Law 480.

The program has undertaken the publication of three series: hardcover onographs, reprints of articles of note dealing with the Southern Asian region, nd a series of occasional papers. It also brings visiting Asian scholars to the mpus for lectures and symposia, and co-sponsors forums and research activities ith the Carolina Population Center of the University of North Carolina, the outhern Atlantic States Association for South Asian Studies, and the Association f Asian Studies.

Inquiries should be addressed to the Administrative Assistant, Program in omparative Studies on Southern Asia, Duke University, Durham, North Carolina 7706.

ooperative Program in Teacher Education

Secondary) (M.A.T. Degree)

Selected graduates of liberal arts colleges who have not completed a teacher reparation program will be admitted to the Cooperative Program in Teacher

Education to complete simultaneously in their graduate programs requirements fo a teacher's certificate and additional training in the field to be taught. Full-year ir ternships with salary are arranged with cooperating public and private schoc systems. Students admitted to this program are required to attend the first summe session before their internship. This program is limited to students preparing t teach biology, English, mathematics, and social studies in junior and senior hig schools. For materials describing this program, write to the Graduate School, 12 Allen Building, or to Director, Cooperative Program in Teacher Education, De partment of Education, West Duke Building.

Cooperative Programs with Neighboring Universities

Interchange of Registration. (See Registration, the Reciprocal Agreement with Neighboring Universities.)

Library Exchange. Students of both the University of North Carolina an Duke University are granted certain library privileges in the libraries of eac university. Books available in one library may be procured through an interlibrar loan service.

Cooperative Program in Russian and East European History. The Grad uate Schools of Duke University and the University of North Carclina offer cooperative program leading to the M.A. and Ph.D. degrees in several discipline (economics, history, literature, linguistics, political science, sociology) with concentration in Russian and East European Studies. Students admitted to on institution are encouraged to enroll in those courses at the other institution tha are advantageous to their programs, and to utilize the libraries and facilities o both universities. The holdings of the two libraries in Russian and East Europea materials are substantial and complementary. Both libraries have a policy o purchasing all significant published works in Slavic history, economics, government geography, literature, and linguistics. Other joint activities include a monthly colloquium involving the personnel of the two institutions and distinguished visitin scholars.

Center for Demographic Studies

A Population Studies Program was established at Duke University ir 1963 to promote research and training in demography and human ecology. The Program was redesignated as the Center for Demographic Studies in 1972 ir recognition of its broad multidisciplinary focus and expanded research programs.

Training under the auspices of the Center leads to a Ph.D. degree withir either the Department of Sociology or the Department of Economics. Althougt degrees are awarded through either department, the program is designed to provide an integrated cross-disciplinary training in the common specialty area ol population studies. The bearing of sociological and economic theory upon the analysis of demographic phenomena is emphasized and participation in active research projects is afforded Center Trainees.

In addition to course and research opportunities, which are open to any interested graduate students in the University, a weekly non-credit seminar meets throughout the academic year for presentations by students, staff, and visiting guest lecturers.

Graduate Fellowships for students in the training program are available. nquiries may be directed to Dr. George C. Myers, Director, Center for Demographic Studies, Box 4732, Duke Station, Duke University, Durham, North Carolina 27706.

Duke Environmental Center

Environmental and ecological programs exist in several departments and chools at Duke University, including botany, engineering, forestry, medicine, and zoology. In order to provide better coordination among these programs and to stimulate further teaching and research in environmental subjects, the Duke Environmental Center was formed in January, 1972.

The purposes of the Duke Environmental Center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects for both students and faculty, to promote interdisciplinary environmental research and to serve as a point of contact for the University and environmental agencies and the public. The Center does not offer degrees, but allows students and faculty to emphasize environmental aspects of their studies and research by becoming affiliated with the Center while remaining in their established departments and professional schools. The Center sponsors a visiting speakers program, graduate and faculty seminars, and an undergraduate course in environmental studies to be offered for the first time in the spring semester of 1973.

A reference room containing books, periodicals, and research papers on environmental subjects is open to students, faculty, and the public in room 206 Old Chemistry Building. Information on environmental programs and courses offered at Duke and other Research Triangle institutions and on internships and opportunities in environmental careers may be obtained by writing or visiting the Environmental Center Office in 210 Old Chemistry.

The University Program in Genetics

The University Program in Genetics was established to provide for the coherent development of instruction and research in genetics throughout the University. The faculty of the Program consists of scientists holding primary appointments in the various biological science departments who have joined together in developing an interdepartmental graduate curriculum designed to meet the needs of students with a wide variety of educational background and professional objectives. Students in any of the science departments may specialize in genetics under the auspices of the interdisciplinary University Program in Genetics.

Program in the History of Social Sciences

An interdisciplinary program in the history of the social sciences has been established at Duke University under a grant from the National Science Foundation. Training and research is directed toward the origins and development of the social sciences, new critical assessments of current theory, and methodology. Participating students are Ph.D. candidates in the social sciences, who are exposed to sociological, philosophical, and historical analyses of the development of their subjects in an interdisciplinary context.

The nucleus of the program is an interdepartmental seminar, and speci courses on such relevant topics as the History of Economic Thought and Ec nomic Policy and the Sociology of the Social Sciences are included in the syllabu Visiting scholars from other institutions and abroad are invited occasionally contribute to the program.

Fellowships for graduate students are provided from the National Scien Foundation grant and from other University sources. Students may pursue degre in one of the following departments: Anthropology, Economics, Political Scienc or Sociology. The stipends, renewable annually upon successful completion the year's work, provide support for two years of course work and one year dissertation preparation. Some assistance is also given for travel to special libra collections and archives.

The Perkins Library at Duke contains exceptionally strong holdings in th history of the social sciences, including books, periodicals, and manuscript Another resource (published by the Duke University Press) is the *History* *Political Economy,* a journal devoted to the history of economic thought.

Inquiries should be addressed to the Program in the History of the Soci Sciences, Duke University, 2101 Campus Drive, Durham, North Carolina 2770

Hispanic Studies Program

The Graduate School offers an interdepartmental program of Hispani studies leading to the A.M. and Ph.D. degrees. Students may write their these and take their degrees in history, economics, political science, sociology, Hispanic languages and literatures. The purpose of the program is to mak possible a desirable combination of courses on the Hispanic world in these relate disciplines and to bring to bear more strength of the faculty upon the training a single candidate. This may be achieved through a judicious use of related fields by such special arrangements as may from time to time become necessary.

The Duke University library holdings have been built up to facilitat graduate work and research in Hispanic-American cultural history, inter-America relations, economic history, politics, and Spanish-American literature. These collections are being enlarged constantly.

Materials-Fields-Mechanics Research Program

The Graduate School offers an interdisciplinary program in materials research leading to the M.S. and Ph.D. degrees. Students write their theses an take their degrees in one of the engineering departments but have access to th resources of an interdepartmental faculty, comprising the Materials Researc Group. The purpose of the program is to encourage and facilitate research o the interactions of materials with various fields (stress, thermal, electromagnetic fluid, etc.).

Requests for information about specific research areas available may b obtained through the directors of graduate studies in biomedical, civil, electrical and mechanical engineering.

Medical Scientist Training Program

The School of Medicine and the Graduate School of Duke Universit cooperate in offering this program which leads to both the M.D. and the Ph.D

degrees. The purpose of this program is to educate scholars who are competen both as physicians and as investigators. Graduates of this program generally pursue careers in faculty positions in medical schools of this country and contribute significantly, through their research and teaching efforts, to the advancement of medical science and practice.

It is expected that students in this program will spend three years enrolled in the School of Medicine and approximately four years enrolled in the Graduate School. Thus, the program is designed to allow participants to achieve both degrees in less time than would be required to obtain them separately. The first two years of study are spent in the core curriculum of the School of Medicine, consisting of preclinical (first year) and clinical (second year) sciences. The participants then devote full time to graduate studies in one of the basic science departments of the University. When requirements for the Ph.D. degree have been completed, students return to the School of Medicine for an additional year of elective clinical experience and thus complete the requirements for the M.D. degree.

Applicants for this program must satisfy the admissions requirements of the School of Medicine and of science departments of the Graduate School. In addition, they should be able to offer some evidence of a serious career interest in research in basic sciences related to medicine. Funds are available which provide for payment of stipends and tuition for the duration of the students' participation in this program. Nine students admitted to this program each fall are fully funded in this manner. Additional students may be provided with funds during the years spent earning the Ph.D. degree.

Inquiries concerning this Program should be directed to Dr. Robert Fellows, Associate Director, Medical Scientist Training Program, Box 3709, Duke University Medical Center.

The Medical Historian Training Program

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School to provide professionally trained medical historians and is supported by the Josiah Macy Jr. Foundation. A minimum of six years of graduate study is required. Upon satisfactory completion of the program, the Doctor of Medicine and Doctor of Philosophy degrees will be awarded. It is anticipated that graduates will undertake a minimum of one year of postgraduate medical training, following which their major effort will be in teaching and scholarly activities in the field of the history of medicine with minor clinical responsibilities.

Basic requirements are two academic years in the School of Medicine consisting of "core" basic sciences in the first year, ending with the course Introduction to Clinical Medicine, and "core" clinical sciences during the second year, following which the student enters the Department of History in the Graduate School.

Candidates for the Ph.D. degree in history devote approximately two full years to the completion of their required courses, work in seminars, and preparatory study of their preliminary or qualifying examinations. The actual length of time needed to earn the Ph.D. degree depends upon the number of years beyond this two-year period candidates find necessary for research and writing of their dissertations. Candidates will pursue studies in the Department of History during the third and fourth academic years of the program. In the fifth and sixth years, the student should have one year in which to pursue medical-historical research and one year of elective courses in the School of Medicine to fulfill the requirements for the M.D. degree.

Application and Admission Procedures. Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History. Candidates who have completed two years of medical school will also be considered.

In addition to the minimum requirements established by the School of Medicine and the Graduate School, courses in history and the history and philosophy of science will count heavily in the selection of candidates.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History.

Additional information may be obtained by writing to Gert H. Brieger, M.D., Ph.D., Director, Medical Historian Training Program, Box 2914, Duke University Medical Center, Durham, North Carolina 27710.

Program in Medieval and Renaissance Studies

The Graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. requirements for that discipline, and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance areas (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art history, language and literature, history, philosophy, and religion. In other words, the student is enabled to minor in medieval and Renaissance studies.

The Committee on Medieval and Renaissance Studies awards an annual fellowship to an entering student with an outstanding record. This fellowship is renewable twice, renewal being based on a review of the student's program by the Committee.

The Committee on Medieval and Renaissance Studies sponsors also an undergraduate program, the *Journal of Medieval and Renaissance Studies*, a monograph series in the field, and lectures by distinguished visiting scholars.

Inquiries should be addressed to the Chairman of the Duke University Committee on Medieval and Renaissance Studies, Box 466, Duke Station, Durham, N.C. 27706.

Predoctoral Training Program in Sciences Related to the Nervous System

This is a training program to develop scientists with an especially broad understanding of the current status, techniques, and approaches of the several disciplines contributing to our knowledge of the nervous system, behavior, and mental health. Participants will work toward the Ph.D. degree in one of the departments listed below. In lieu of the minor field of study, they will receive expanded learning experiences in the form of a broad based curriculum, tutorial courses, and seminar series in the current issues of neurobiology. In view of the diversity of the topic, each curriculum will be fitted to the individual's needs and interests by a special committee. This program is especially designed to foster the development of individuals with a broad understanding of the neurosciences yet fully equipped to contribute to the expansion of our knowledge by means of research in his field of expertise. Annual stipends range from $2,400 to $2,800. Dependents are allowed $600 per annum each. Participating departments: Anatomy, Microbiology and Immunology, Physiology and Pharmacology, Biochemistry and Genetics, Pathology, and Psychology. Further information may be obtained by writing Frans F. Jobsis, Ph.D., Chairman, Training Committee, or Walter D. Obrist, Ph.D., Program Director.

Oak Ridge Institute of Nuclear Studies

Duke University is one of the sponsoring universities of the Oak Ridge Institute of Nuclear Studies located at Oak Ridge, Tennessee. The graduate research program at Duke has available to it all the facilities of the Oak Ridge National Laboratory and the cooperative supervision of student research by the staff at Oak Ridge. Fellowships in several fields of science are available to qualified applicants.

Graduate Fellowship Program. On application by a university, the Institute awards fellowships to candidates for the master's and doctor's degrees. The student uses the fellowship to conduct his thesis research in an Oak Ridge laboratory.

AEC Special Fellowships. These are available in the fields of (1) nuclear science and engineering, (2) health physics, (3) advanced training in health physics, and (4) industrial hygiene.

The application deadlines differ for different fellowships. Further information may be obtained from Lewis E. Anderson, Department of Botany.

Organization for Tropical Studies

Duke University is a member of a consortium created to promote an understanding of tropical environments and their intelligent use by man. To achieve these objectives, OTS fosters research and educational programs in the New World tropics.

Fellowships are available for travel and subsistence in field-oriented programs in Central America. The basic course, Tropical Biology: An Ecological Approach, runs for an eight-week period in February-March and July-August. Advanced offerings are periodically scheduled in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

The course schedules and application deadlines vary from year to year. Consult the respective university departments for current information on OTS activities, or Dr. Donald Stone (Botany) and Dr. Peter Klopfer (Zoology).

Social Systems Simulation Program

This is an interdisciplinary program to stimulate the use of model building and computer techniques in the social sciences. Although an outgrowth of the Econometrics Program, it is broadly based in that it involves faculty participation from business administration, economics, education, mathematics, political science, psychiatry, psychology, and sociology. It provides resources and facilities to predoctoral students pursuing Ph.D. work in a variety of fields. Inquiries should be addressed to the Director, Social Systems Simulation Program, P. O. Box 4774, Duke Station, Durham, North Carolina 27706.

Center for Southern Studies

The Center for Southern Studies engages in interdisciplinary inquiries into both the contemporary and historical South. Concerned both with scholarly research and its practical application in the emerging industrial states of the region, the Center has been instrumental in the creation of a multi-state Southern Growth Policies Board to foster regional economic planning. Under the auspices of the Board, Southern business, labor, educational, and political leaders, including nine governors, are engaged in developing modern approaches to problems of basic concern.

The Center's Oral History Project focuses upon the development of additional Black sources on the Southern past with a view toward fostering a multiracial history of the region. The Center is also cooperating with the Department of History in the training of graduate students in oral research methodology.

The Center offers an interdisciplinary undergraduate course on The Changing South (IDC 199) which explores the geography, economics, politics, and culture of the region. As an adjunct of this course, the staffs of the Center and the Perkins Library have created a Center for Southern Studies Reading Room containing over 300 volumes relating to the historical and contemporary South.

Inquiries may be directed to Dr. Thomas H. Naylor, Director, Center for Southern Studies, Box 4774, Duke Station, Duke University, Durham, North Carolina 27706.

Stochastic Systems Program

A comparative program in stochastic systems analysis is sponsored by the Department of Electrical Engineering at Duke and the Department of Statistics of the University of North Carolina at Chapel Hill, in cooperation with the Departments of Mathematics at the two institutions. The program is designed for graduate students interested in applications of stochastic processes and statistical inference. A student interested in this area may enroll in any one of the sponsoring or cooperating departments in a program leading to a master's or a Ph.D. degree, awarded through that department. Mutual interaction between the departments is provided by complementary course offerings and cooperative student advising. The student may thus arrange a variety of programs within the general stochastic systems area, emphasizing the more theoretical or the more applied aspects at his discretion. In addition to the courses regularly available, special courses will be offered on various topics. A stochastic systems seminar is an integral part of the program. Further information concerning this program may be obtained from either the Director of Graduate Studies, Department of Electrical Engineering, Duke University, or Dr. C. R. Baker, Department of Statistics, University of North Carolina, Chapel Hill 27514.

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Resources for Study

The Libraries

The William R. Perkins Library has shelf space for 1,500,000 books, seats for 1,250 readers, and a staff of 200. With the completion of the renovation of the old building in the spring of 1970, the entire complex provides room for 2,500,000 books and 2,100 readers. The reader stations include about 700 carrels, 200 closed and 500 open, of which 475 are in the new building.

On the main floor—at ground level—are the reference and loan departments, bibliography, current periodicals, interlibrary loan, and all units of technical processing. Documents, newspapers, microtext collection, and the microphotography laboratory and other copying facilities are located on the floor below. The administrative offices and graduate reading room are on the second floor, and manuscripts and archives on the third. Twelve small reading and study rooms are provided in the stacks for the departments in the humanities and social sciences that grant the doctorate. Four seminar rooms are also provided in the stacks.

Microphotography and photographic services utilize modern equipment for reproducing printed and manuscript materials and for the reading of materials in the microtext collection. A special room has been set aside for film readers.

In addition to the Perkins Library there are nine school and departmental libraries with holdings of some 2,337,000 volumes. The Perkins Library has 1,426,000 volumes; the Undergraduate Library, 12,800 volumes; Divinity School, 160,800 volumes; Engineering, 49,000 volumes; Law, 176,500 volumes; Medical Center, 120,000 volumes; East Campus Library, 202,500 volumes; Biology-Forestry, 116,600 volumes; Chemistry, 29,000 volumes; Mathematics-Physics, 43,300 volumes. Over 100,000 volumes were added in 1971-72. Approximately 11,000 periodicals and 185 newspapers are received currently.

The extensive resources of the Library for research students may be suggested by the following special collections:

The Trent Collection of Walt Whitman, containing the first and all other important early editions or issues of *Leaves of Grass*; books and articles of Whitman biography and criticism; nearly 300 manuscripts and 400 letters; and pictures, sheet music, and other miscellanea.

The George Washington Flowers Collection of books, manuscripts, pamphlets, and newspapers on all phases of Southern history.

The Arents Collection of several hundred volumes relating to the culture and production of tobacco and the manufacture and distribution of tobacco products.

The James A. Thomas Collection of books on Chinese history and culture.

The Guido Mazzoni Library, a collection of approximately 23,000 volumes and 67,000 pamphlets covering the whole range of Italian literature, with special strength in the nineteenth century.

The Gustave Lanson Library of 12,000 books and monographs on French literature.

Latin-American Collections, built around a special Peruvian library of 7,000 books and manuscripts, a Brazilian library of several thousand volumes, and an Ecuadorian library of 2,000 volumes, supplemented by strong collections of the public documents of these and other Latin-American countries.

The Robertson Library of Philippiniana.

The Frank C. Brown Folklore Collection, consisting of about 38,000 manuscript pieces, 1,400 vocal recordings, and 650 musical scores of North Carolina folklore.

The Strisower Library of international law, numbering about 5,000 volumes, with many rare books and periodical files.

The Trent Collection in the History of Medicine (Medical Center Library), containing about 3,000 books and 2,500 manuscripts with special strength in anesthesia, anatomy, English medicine, vaccination, yellow fever, pharmacy, and medical biography.

The Holl Church History Library, dealing primarily with the period of the Reformation.

The Frank Baker Collection of Wesleyana and British Methodism, consisting of 1,500 editions of the works of John and Charles Wesley, 8,000 volumes concerning all phases of the development of British Methodism, 4,000 volumes relating to the religious and social background of British Methodism, and 4,000 manuscript pieces by the Wesleys and their coadjutors and by British Methodists of the last 200 years.

Collections in English and American Literature, where emphasis has been placed principally on the eighteenth and nineteenth centuries, with the collections of Swinburne, Tennyson, Rossetti, and Bryant, significant groups of annotated copies and first editions of Coleridge and Byron, the Carroll Wilson collection of Emerson, some 5,000 items of eighteenth-century English poetry and prose, and the Paul Hamilton Hayne library of American literature.

In addition to these and other special collections, the libraries contain excellent files of United States federal and state documents, public documents of many European and Latin American countries, and publications of European

academies and learned societies. The newspaper collection, with 15,000 volumes and 30,000 reels of microfilm, has several long eighteenth century files, strong holdings of nineteenth century New England papers, and of antebellum and Civil War papers from North Carolina, South Carolina, and Virginia; there are also many European and Latin American papers. The manuscript collection of over 4,000,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region, although it also includes significant papers in English and American literature, and several notable medieval manuscripts in both Greek and Latin.

Science Laboratories

Botanical and Zoological Laboratories. Facilities for graduate study in the Departments of Botany and Zoology are located on the West Campus. The Biological Sciences Building, completed in 1962, contains well-equipped modern laboratories for teaching and research in the various fields of botany, forestry, and zoology. Special facilities are available, such as animal rooms, greenhouses, darkrooms, refrigerated and controlled-environment laboratories, scanning and transmission electron microscopes, a Van de Graaff accelerator, X-ray machines, radiation and radioisotope equipment, and other modern research facilities. Extensive facilities for experimentation in the environmental control of plant growth are available in the new phytotron adjacent to the botany greenhouses.

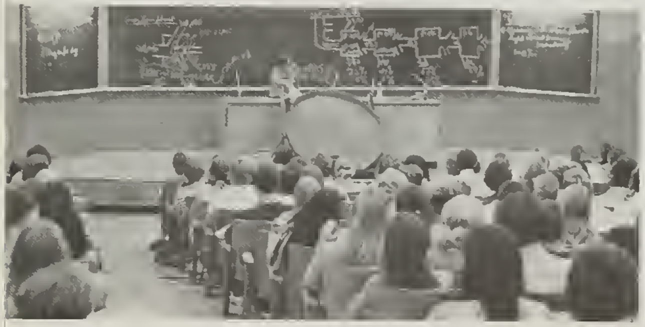
The Herbarium, containing over 360,000 specimens, is worldwide in scope and includes notable collections of mosses and lichens. Other unique assets for teaching and research are the Sarah P. Duke Gardens, conveniently located on the West Campus; the four-acre experimental plot and field laboratory developed by the Department of Botany; the Duke Forest, comprising 8,000 acres of woodland adjacent to the West Campus; the field station for the study of animal behavior; and the Duke University Marine Laboratory at Beaufort, North Carolina. Duke University, through the Botany and Zoology Departments, is a member institution of the Organization for Tropical Studies in Costa Rica, a facility providing excellent opportunities for course work and research in tropical flora and fauna.

Scholarships for advanced study during the summer months are maintained at the Highlands Biological Laboratory, Highlands, N.C.; at the Marine Biological Laboratory, Woods Hole, Massachusetts; and at the Duke University Marine Laboratory. Requests for information concerning scholarships at the Highlands Laboratory should be addressed to the Botany Department, those at Woods Hole to the Zoology Department, and those at Beaufort to the Duke University Marine Laboratory.

The Phytotron. The phytotron, officially known as the Duke University unit of the Southeastern Plant Environment Laboratories, is connected to the Biological Sciences Building on West Campus. The facility is administered by the Botany Department. The phytotron is an integrated series of plant-growth rooms, chambers, and greenhouses. Over fifty separately controlled environments provide more than 3,000 square feet of plant growing space. The controlled units consist of artificially lighted rooms with temperature and humidity control, reach-in chambers, and six temperature-controlled greenhouses. By using the conditions in various day and night combinations an exceptionally large number of environments can be obtained for testing the growth responses of plants. The phytotron also includes research laboratories and facilities for studying and monitoring the physiological processes of plants.

Research space in the phytotron is available to graduate students and faculty at Duke and to members of other educational and research organizations. For information concerning awards and research space, write to the Director, Dr. Henry Hellmers, Department of Botany, Duke University, Durham, North Carolina 27706.

Marine Laboratory. The Duke University Marine Laboratory is located at Beaufort, North Carolina, one and one-half miles from the open ocean. The physical plant includes six well-equipped research buildings, including the recently completed three-story research facility, six classrooms, and four dormi-



tories, two of which are heated and air-conditioned for year-round use. The Laboratory provides excellent facilities for summer graduate courses in botany, chemistry, geology, zoology, biochemistry, and physiology and for thesis research throughout the year. Special research and training facilities for field work in marine biology and biological oceanography include two motor vessels and a 118-foot biological research vessel *Eastward*, with specialized apparatus for collecting and environmental measurements.

For information concerning research space, write to the Director, Dr. John D. Costlow, Duke University Marine Laboratory, Beaufort, North Carolina 28516. For information concerning courses refer to Marine Sciences—the University Program in the section on Courses of Instruction.

Animal Behavior Station. Located less than one mile from the campus, the 80-wooded acres of the station provide facilities for the studies of penned, free-ranging, and caged animals. These facilities include soundproof observation chambers, barns, aviaries, and pens for large mammals and birds, and two water-fowl ponds. An extensive facility for the study of prosimian primates (both simulated natural habitats and cages) was completed in 1968. For information regarding research space or research assistantships in animal behavior, write to Dr. P. H. Klopfer, Department of Zoology.

Primate Facility. A large colony of prosimian primates is housed in the Duke University Primate Facility, adjacent to the Field Station for the Study of Animal Behavior. Research programs in biochemical and molecular genetics, cytogenetics, comparative anatomy, behavior, and reproduction are conducted with the use of the animals as a major resource. For information about graduate study in primate biology and about research space, write to Professor John Buettner-Janusch, Department of Anatomy.

Physics Laboratories. The Physics Building, containing about 130,000 square feet of floor space, is devoted to research and instruction in the Departments of Physics and Mathematics. An additional 27,000 square feet of space are provided in the Nuclear Physics Building completed in 1968 and located adjacent to the Physics Building. Graduate students are provided with office space in one of these two buildings.

In addition to the lecture halls and the elementary laboratories, there are instructional laboratories for work in electronics and advanced physics.

About half the building is devoted to special laboratories for research in microwave spectroscopy, atomic, nuclear, high energy, low temperature, and solid state physics. Special equipment includes microwave spectrographs operating up to 500,000 megacycles; one 4 MEV and one high resolution 3 MEV Van de Graaff accelerator, a 30 MEV cyclotron/tandem Van de Graaff accelerator; a helium liquefier, cryostats, magnets, and associated equipment for research down to the millidegree Kelvin temperature range; a Sigma-5 and a DDP-24 computer used for automatic measurement and processing of bubble chamber film in the High Energy Physics Laboratory; and two DDP-224 computers used to collect and process data in the Nuclear Structure Laboratory.

The Physics-Mathematics Library contains an unusually complete selection of books and periodicals. A large, well-equipped instrument shop staffed by ten instrument makers, ten electronics technicians, and a glass blower is in the building.

Chemistry Laboratories. The Chemistry Department occupied a new building in 1969. Named after Dr. Paul M. Gross, a distinguished member of the faculty

for many years, the building contains three and one-half floors which provide 146,440 square feet of total area. The usable space is over twice that of the original building, and will allow considerable growth of departmental research programs as well as faculty and student body. The entire building is air-conditioned and is electrically heated.

The Chemistry Department is well equipped for performing research in many areas of current interest. Among instruments available for general use in various research problems are Varian T-60 and A-60 Nuclear magnetic resonance spectrometers, a Varian C-1024 time averaging computer, a Consolidated Electrodynamics Corporation Type 21-490 mass spectrometer, a Bendix time-of-flight mass spectrometer Model 12, a Perkin-Elmer Model 621 infrared spectrophotometer, and other recording spectrophotometers for infrared and ultraviolet-visible studies. The department also utilizes numerous analytical and preparative gas chromatographs. Some other instruments of primary importance to specific research projects include Varian V-4502-12 and V-4502-15 electron paramagnetic resonance spectrometers, Varian HR-60 and Bruker 100 Mc HFX-10 nuclear magnetic resonance spectrometers, a DSC-1B differential scanning colorimeter, a Baird-Atomic Fluorespec spectrofluorimeter, Carey Model 14R and Model 15 ultraviolet-visible spectrophotometers, a Durrum-Jasco ORD/UV/CD-5 recording spectropolarimeter and circular dichroism recorder, a Durrum-Gilison stopped flow spectrophotometer, polarographs, a flame photometer and optical equipment for photochemical and kinetic studies. Equipment for X-ray crystallographic investigations includes a Rigaku-Denki low-angle X-ray diffractometer, a Kratky U-Bar camera, a General Electric XRD-5 diffractometer, a Picker automated full-circle X-ray diffractometer, and Enraf-Nonius automatic diffractometer, Debye-Scherrer powder cameras, and single crystal Weissenberg and precession cameras.

The department has a machine shop, an electronics shop, and a glass-blowing shop. The facilities of the Duke University Marine Laboratory on the coast at Beaufort, North Carolina, are available for specimen collection and processing in studies of organic chemicals of marine origin.

Nanaline H. Duke Building. The Nanaline H. Duke Medical Sciences Building offers a superb environment for the creative research and graduate education of members of the faculty and students in the Departments of Biochemistry and

Genetics and Physiology and Pharmacology. The building provides more than 140,000 square feet of laboratory space arranged in four towers around a central service core. Individual laboratories were uniquely designed to meet the special needs of research programs about living organisms. Controlled environment rooms, dark rooms, electronics shops, a library, conference and reading rooms, and a materials-purchasing facility are provided. A vivarium for the temporary care and treatment of experimental animals is available. As an integral part of the basic medical science complex, the Nanaline H. Duke Building is truly symbolic of the highest goals of the University: to pursue the quest of man to understand himself and his surroundings.

Psychology Laboratories. The Psychology Department occupies about 53,000 square feet of air-conditioned space on the main campus which houses its main laboratories, seminar rooms, classrooms, and special facilities. There is a periodical room in the building, for the use of psychology graduate students and staff, which houses some psychology journals and the Psychology Department book collection. Duplicates of books and journals are housed in the main library 150 yards away. In addition to general purpose laboratories, there are a number of special facilities: for the study of animal behavior there are video-tape-recording facilities, a breeding colony of ring doves and pigeons, and an extensive collection of prosimians, as well as operant conditioning laboratories. There are soundproofed and electrically shielded rooms for use with human and animal subjects. Specially equipped rooms are available for computer-controlled experiments in human perception and memory. A number of electrophysiological recording rooms are available, as well as a histological laboratory and surgery. There are photographic darkrooms in the building. The social psychology unit (used jointly with the Department of Sociology) contains observation, communication, and video-tape-recording facilities for the study of social interaction. There is an extensive suite of interview and observation rooms for the study of human personality and clinical processes. The department has a fully equipped experimental trailer for studying the behavior of children on location. Both laboratory computers and remote access to the TUCC IBM 370 Model 165 are available in the building. The department is well supplied with technical help in the form of machine, wood, and electronics shops staffed by three full-time technicians. Other facilities for research and teaching are available in the laboratories and clinics of the adjacent Duke Medical Center.

A number of clinical installations for adults and children, devoted to an extensive range of clinical and guidance problems, cooperate with the department in providing facilities for research and training. In addition, the department operates an experimental school for first- and second-grade and preschool children. The department cooperates with the Department of Zoology in the operation of an 80-acre field station and primate facility in the nearby Duke Forest for the study of animal behavior in natural settings (see Animal Behavior Station).

Computation Center. The Duke University Computation Center provides the University faculty and students with a facility for research and instruction.

The center is presently equipped with an IBM System 370 Model 135 (240K bytes, one 2314 disk facility, three tape drives, two card readers, two printers, and a Calcomp plotter) which is connected by high-speed telephone lines to an IBM System 370 Model 165 (two million bytes of memory, one 3330 and two 2314 disk facilities, five tapes, card reader, and printer) located at the Triangle Universities Computation Center which is in the Research Triangle Park. In addition, there are two medium-speed terminals (card reader and printer) located in

the Engineering Building and in the Sociology-Psychology Building, and several low-speed keyboard terminals.

The Triangle Universities Computation Center (TUCC) is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. The purpose of the TUCC is to provide computing capabilities equal in quality to the finest available.

Faculty members at Duke may use the facilities of the Computation Center by filling out an application for computer services. All users of the Computation Center facilities are urged to obtain funds to pay for computer services. However, any user unable to obtain grant funding may ask for financial support from his department when he applies for the services.

More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

Engineering Research Laboratories. The laboratories of the four departments which comprise the School of Engineering contain a wide range of basic equipment that finds general application in the several fields of specialization. In addition, each laboratory contains selected items of highly sophisticated equipment used to support advanced research in areas of particular emphasis. The exceptionally fine facilities available for instruction and research are suggested by the following brief listing of selected items to be found in the four departments:

Biomedical Engineering. Holography and ultrasound apparatus; high energy CW helium-neon gas laser, and interferometrically stable table; cellular electrophysiology and neurophysiology instrumentation; stereomicroscope, micromanipulators, stimulators, isolation units, and microelectrode puller; facilities for studying biomedical materials and surface interactions; polarizing microscope, internal reflectance infrared spectrophotometer, and dialyzers; cardiorespiratory measurements; respirator, pressure transducers, and DEC PDP-12 digital computer.

Civil Engineering. Closed-loop, electrohydraulic dynamic loading system capable of applying pulses of any shape, of magnitudes up to 5,000 pounds, and controlled in either force or displacement modes in frequencies from zero to 100 cycles per second; vacuum-forming facilities for structural shell models; high-speed digital strain-measuring and recording systems; ultra-high-pressure triaxial shear apparatus for confining pressures up to 100,000 p.s.i.; high-speed camera for studying explosions and similar phenomena; large-aperture research polariscope; reflective photoelastic polariscope; sustained-loading facility for long-duration studies of prestressed concrete.

Electrical Engineering. High-resolution (7Å) electron microscope with heating and tilting stage; stereo-optical microscopes; ion-pumped bakeable ultra-high vacuum unit; helium dewars and cryostats; 4 inch and 9.5 inch electromagnets and 2 inch bore superconducting magnet; electron paramagnetic and nuclear magnetic resonance spectrometers; X-ray diffractometer with monochromator attachment; x-band microwave instrumentation; cryomagnetic facility for susceptibility measurements; analog and digital computer facilities including DEC Linc 8, PDP-8/I, and PDP-11/45 computers.

Mechanical Engineering. Digital data acquisition system with high speed scanner and magnetic tape; FM-AM instrumentation recorder; 4 square foot subsonic wind tunnel with six-component balance; hot-wire anemometer system; storage and dual-beam oscilloscopes; X-Y and strip chart recorders; temperature, pressure, strain, force, and acceleration transducers; electrodynamic shaker table; sound room; spectrum analyzers; analog computer facility; experimental pneumatic-tube transportation system (1800 ft. x 1 ft. diameter); fuel research engine; materials laboratories with stereo-zoom research metallograph, thermal analyzer, Instron testing machine, high-vacuum system, 10 kw RF generator, heat-treating and arc-melting furnaces, recorders and darkroom.

Available to graduate students in all four departments of the School of Engineering are also the Central Service Shop facilities of the School, as well as those located elsewhere on the campus.

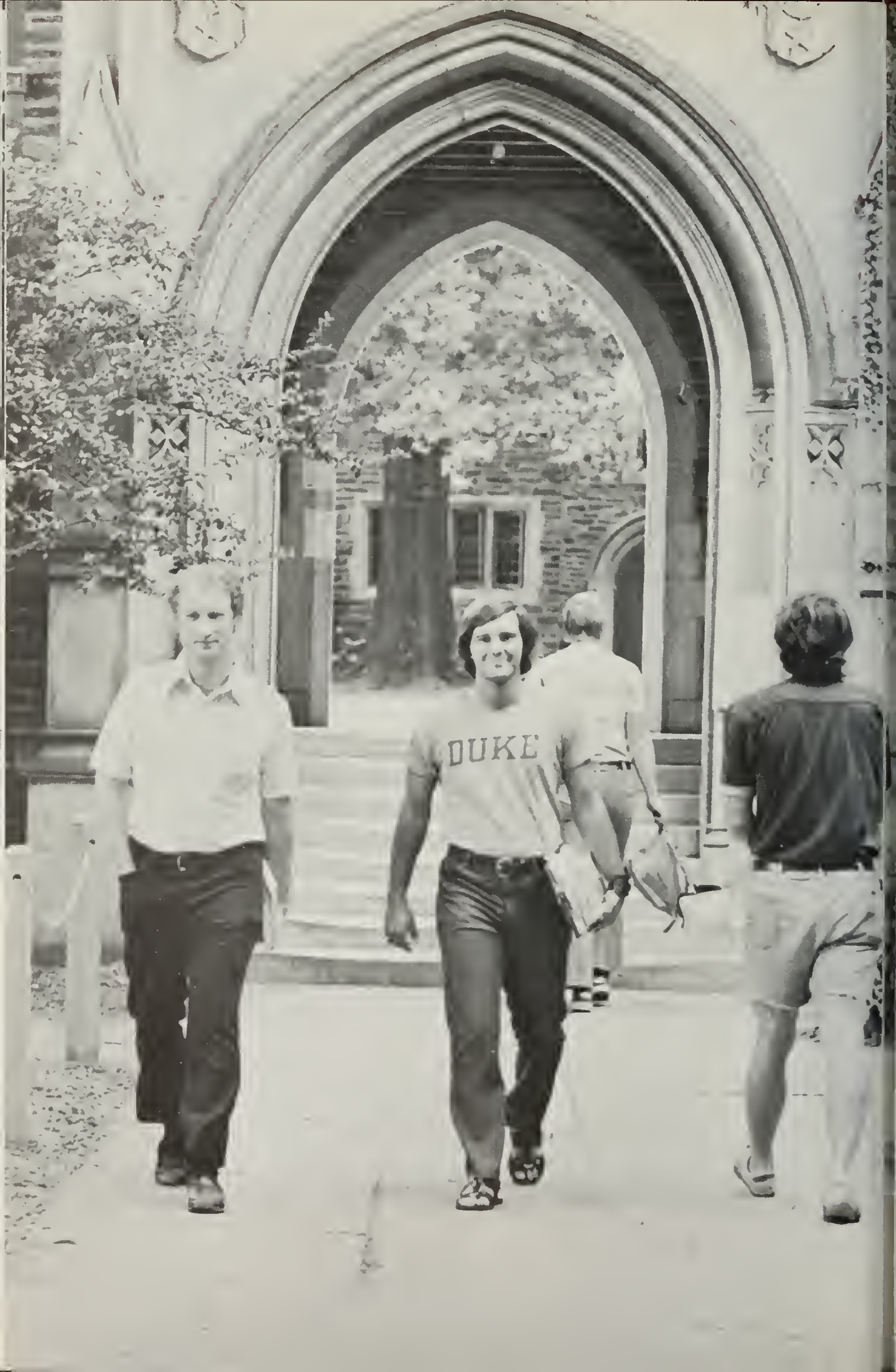
The School of Engineering houses an IBM Model 2780 medium-speed card-reader punch and printer which communicates directly with the IBM System 370 Model 165 computation facility that is located in the Triangle University Computation Center in the adjacent Research Triangle Park.

Forestry Sciences Laboratory. The U.S. Forestry Sciences Laboratory of the Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides outstanding opportunities to complement the research conducted by students in the Department of Forestry. Specialized research projects in forest entomology, pathology, physiology, and soils are currently underway at the laboratory. The staff of the laboratory is available for consultation and participation in seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

Duke Forest. The Duke Forest serves as an outstanding field laboratory for the students and faculty of Duke University. This forest consists of about 8,000 acres on which grow various types of forests characteristic of the southeastern Piedmont region. Shortleaf pine, loblolly pine, and southern hardwoods represent the main timber types.

Much of the Duke Forest is adjacent to the campus and easily accessible for those who are working in the fields; therefore, students and faculty have excellent opportunities to conduct studies in various fields of forestry such as ecology, entomology, land management, meteorology, pathology, physiology, and soils.

Many faculty members and students in other departments of the University such as Botany and Zoology also use the Duke Forest in which to conduct research.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Student Life

Living Accommodations

Housing. Duke University provides residence hall and apartment accommodations for single graduate and professional men and women. Since no married student housing facilities are presently available, the University provides assistance to married graduate and professional school students in locating suitable housing in Durham where varied types of living units are available.

The Graduate Center, near the Medical Center, and Town House Apartments house men and women enrolled on a full-time basis in the graduate and professional schools. Town House Apartments are located between East and West Campuses.

The Graduate Center houses 189 male graduate students, 56 female graduate students, and 117 female undergraduate students. Commons facilities on the main floor are shared by men and women.

Students are normally licensed to occupy graduate residential space for the academic year, but for no period less than a semester or specified term.

Duke University operates Town House Apartments primarily for graduate and professional school students. Others are housed in individual apartments if the interests of the University are served. There are thirty two-bedroom units, each furnished for three occupants. Two students occupy the master bedroom with adjoining half-bath, and the third occupies a smaller bedroom. A living room, kitchen, and full bath complete the living arrangement. Additional features are air-conditioning and a swimming pool. Campus bus service makes the University readily accessible to the Town House Apartments.

The Department of Housing Management is prepared to assist married graduate and professional school students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and duplex units are available in limited numbers from time to time.

Detailed information about University housing facilities for single students, and the housing assistance program for married students, will be provided upon request by the Department of Housing Management, Duke University, Duke Station, Durham, North Carolina 27706.

Rooms in residence halls and spaces in the Town House Apartments or other residential units may be reserved by applicants only if they have been accepted by the graduate or professional schools, and after the required $50.00 residential deposit has been paid to the University. The initial residential deposit is required with the application and is held until the room or apartment is vacated. Application forms and detailed information on graduate housing will be mailed when the graduate or professional schools have notified the Department of Housing Management of official acceptance of the student. Single students may express a choice for the type of housing desired. Completed applications for rooms and apartments are to be returned with the required deposits, to the Department of Housing Management, Duke Station, Duke University, Durham, North Carolina 22706. Assignment priority is established by the date of receipt of completed applications with deposits in this office.

Regulations governing occupancy of rooms and apartments will be provided by the Department of Housing Management at the time application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

For the cost of housing, see the section on Financial Information.

Food Services. Food service on the East Campus is cafeteria style. The dining facilities on the West Campus include one straight-line cafeteria with multiple-choice menus, a free-flow service area which includes cafeteria counters as well as a grill, and a table-service dining room, the Oak Room, where full meals and *à la carte* items are served. The Cambridge Inn, which is a self-service snack bar also located in the West Campus Union, is open from 9:00 a.m. until 12:30 a.m. each day except Saturday. All types of snack and sandwich items are available there. The Graduate Center has a cafeteria open at meal hours, and a coffee lounge which is open until 11:00 p.m. Because of the large number of those served in the dining halls, it is not possible to arrange special diets for individual students.

The cost of meals approximates $2.75 to $3.50 per day, depending upon the needs and tastes of the individual.

Services Available

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. To secure the benefits of these services a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged for, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. The rate for 1972-73 is $29.90 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Participation in this program is on a waiver basis. The University expects all students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may waive the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or sign a waiver before his registration is complete.* The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from August 31. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the Dean of the Graduate School.

The Duke University Counseling Center. Through the Counseling Center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated while a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Office of Placement Services for those students who have registered.

Student Affairs

Co-curricular and Recreational Activities. Graduate students new to Duke University are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the very active Graduate Women's Club.

A full program of co-curricular and recreational activities is presented by the Associated Students of Duke University; Cultural Affairs Office; Duke University Christian Council; Duke University Union; Student Activities Office; Y.M.C.A.; Y.W.C.A. and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; Chaplain's Office, Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University *Annual Calendar;* detailed and updated information in the *Weekly Calendar,* available on each Friday; and the Duke *Chronicle,* available each Monday through Friday. Copies may be obtained at the Information Desk or the Calendar Office, Room 107 Page Building.

Graduate Student Association. The Graduate Student Association provides a formal means of communication between the graduate student body and the faculty and administration. Membership in the association is open to all registered graduate students. This student-organized association meets monthly, with representatives present from the graduate enrollment of each department. The association is governed by a steering committee elected annually from the membership. In addition to other functions, the association provides graduate student representation on many campus committees such as those concerning the library, housing, and governance.

Research and Publications

The several departments of the University are devoted to research as wel as to instruction. Since the University exists for the promotion and diffusion o knowledge, attention is rightly placed in the Graduate School on research activities

To further the University's obligation to promote and diffuse knowledge the President annually appoints a University Research Council which receive applications from members of the various faculties for subsidies in support o research. Vigorous and forward-looking policies of this Council have initiate and encouraged the completion of many substantial and important researc projects.

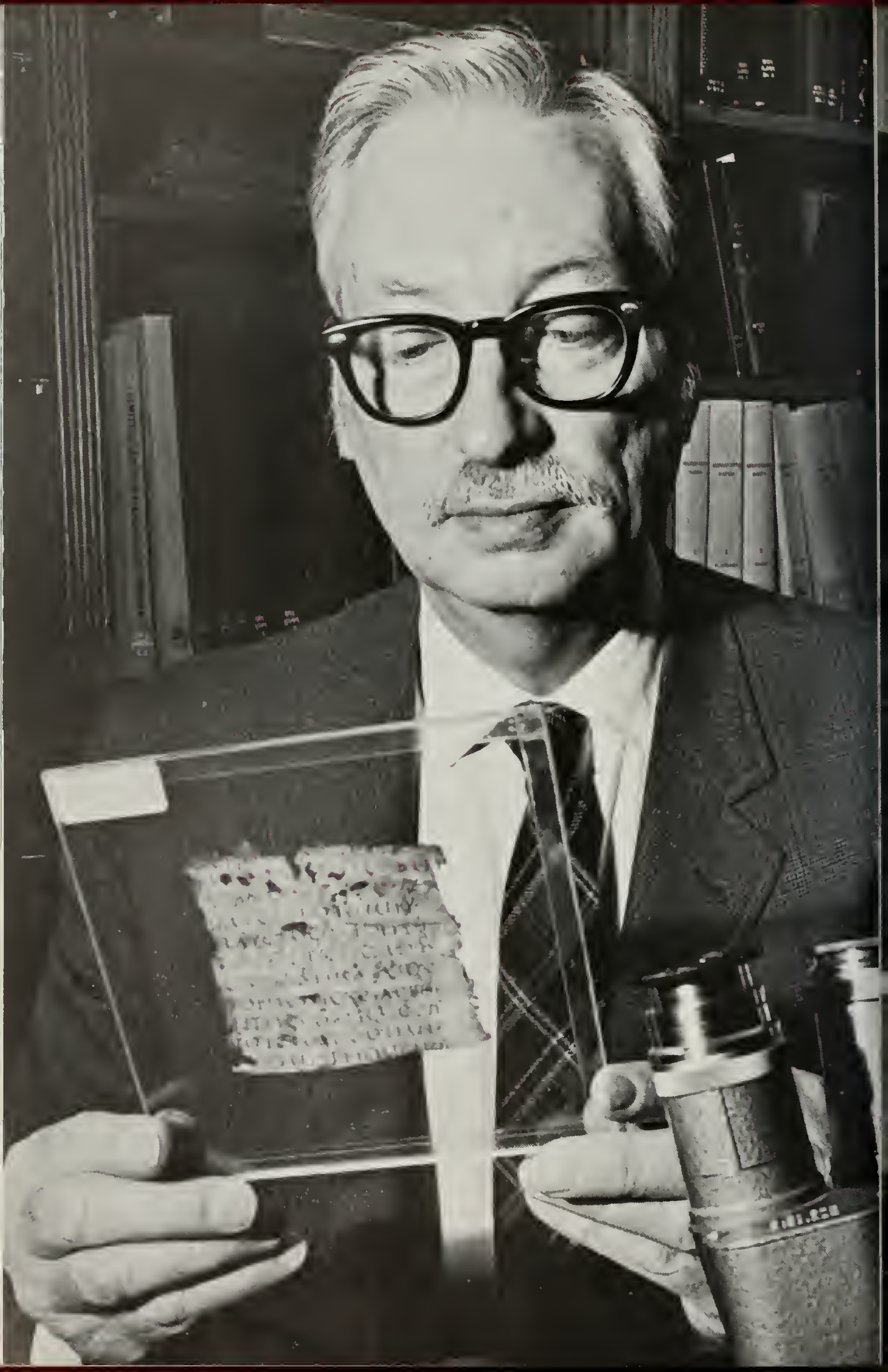
The Duke University Press is a significant agency in the diffusion of completed research. Created in 1925 as a successor to the Trinity College Press, the Duke University Press continued the publication of the *South Atlantic Quarterly*, published at Trinity College since 1902, and in 1926 it revived the *Hispanic-American Historical Review*, which had been founded and published from 1918 to 1922 by a group of scholars interested in Hispanic America. In 1929 *American Literature* was begun with the cooperation of the American Literature Group of the Modern Language Association. This journal was followed in 1931 by *Ecological Monographs*, and in 1932 by *Character and Personality* (since 1945 entitled the *Journal of Personality*). In 1935 the press began the publication of the *Duke Mathematical Journal*. Since 1948 it has published *Ecology*, the official journal of the Ecological Society of America. In 1965 it began annual publication of *American Literary Scholarship*, in 1969 the *History of Political Economy*, and in 1971 *The Journal of Medieval and Renaissance Studies*.

Since its organization the press has published over five hundred volumes. ncluded among these are five series: the Duke Historical Publications, the Duke Studies in Religion, the publications of the Lilly Endowment Research Program in Christianity and Politics, those of the Program in Comparative Studies on Southern Asia, and, largest of all with thirty-eight volumes, the publications of the Duke University Center for Commonwealth Studies. In the broadest sense, the policy of the Press is to make available to the public any scholarly work that merits publication, though special attention is given to works in fields of knowledge cultivated by the University.

The Law School of Duke University publishes *Law and Contemporary Problems, The Duke Law Journal*, and *The Journal of Legal Education*.

Visiting Scholars

The libraries and other facilities of Duke University are, to the extent practicable, made available to faculty members of other colleges and universities who wish to spend a period of time on the campus in pursuit of their scholarly nterests. A special identification card is furnished a visiting scholar by the Graduate School Office. No fees are charged such visitors unless they wish to participate in activities for which a special fee is assessed. Assistance in locating residence may be obtained from the Department of Housing Management. Inquiries pertaining to visiting scholars should be directed to the individual department chairman or to the Dean of the Graduate School.



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Admission

Students Requiring Admission

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as Special Students in the summer session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program. All applicants will be considered without regard to race, color, religion, sex, or national origin.

Prerequisites

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Normally he should have majored in the area of his intended graduate study. Many departments (see Courses of Instruction) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see Language Requirements).

Procedures

A student seeking admission to the Graduate School should request the Dean of the Graduate School to send an application blank. This should be filled out completely and returned promptly. In addition the student should provide the following supporting documents: (1) two copies of a transcript or transcripts of all his undergraduate and graduate work mailed directly by the registrar to the Dean; (2) as soon as possible, two supplementary transcripts showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge him as a prospective graduate student and mailed directly to the Dean; and (4) scores on the Graduate Record Examination, as indicated below.

All applicants except former students in the Graduate School must include the application fee of $15.00 in check or money order payable to Duke University. Applications will not be processed unless this fee has been received.

Graduate Record Examination. Scores on the Graduate Record Examination, particularly the Aptitude Test, are strongly recommended in all departments and must be submitted if the test has been taken. Scores on the Graduate Record Examination may be requested of any applicant whose record is marginal and must be submitted by all applicants for a fellowship. Students applying for financial aid should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704. Departments that require scores of all applicants follows:

Departments Requiring the Graduate Record Examination

Departments	Aptitude	Advanced
Anatomy	X	
Anthropology	X	
Art History	X	
Biochemistry	X	X
Botany	X	X
Business Administration[1]		
Chemistry	X	X
Classics	X	
Computer Science	X	
Economics	X	
English	X	X
Forestry	X	
Geology	X	
German	X	
Health Administration[1]		
History	X	
Mathematics	X	X
Microbiology	X	X
Pathology[2]	X	X
Philosophy	X	
Physical Therapy	X	
Physics	X	X
Physiology	X	X
Political Science	X	
Psychology	X	X
Religion	X	
Romance Languages	X	X
Sociology	X	X
Zoology	X	X

[1] Applicants to the Graduate School of Business Administration and the Department of Health Administration are required to take the Admission Test for Graduate Study in Business, administered by the Educational Testing Service.

[2] If the candidate does not already hold a doctoral degree, he will be required to take the GRE.

Additional Procedures for Foreign Students. Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with his application (1) if his native language is not English, certification of his proficiency in English demonstrated by submitting scores from the Test of English as a Foreign Language (TOEFL), administered through The Educational Testing Service in Princeton, New Jersey, or, if he is in the United States, a statement of his English proficiency written by a professor of English at his university; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per academic year are $4,000); and (3) a statement by a qualified medical doctor describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack

necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units. Tuition charge for this course will be $39.00 per unit. A student who does not successfully complete this course during the first year of his residence will not be permitted to continue his graduate program. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language. (See Language Requirements for Foreign Students.)

Notification of Status. When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the acceptance form has been returned.

Applicants who are admitted will be offered full admission, provisional admission, or non-degree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. *Non-degree admission* is offered to students who (1) have no intention of taking an advanced degree at Duke University but wish to take courses, or (2) do not fully meet admission requirements but wish to further their academic interests. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission; graduate credit earned under non-degree status may not be applied toward an advanced degree at Duke University. (See ruling on page 2.)

Deadlines for Application. It is the applicant's responsibility to make certain that his application is completed and in order before the dates specified. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted at least *two weeks* before the closing dates listed below:

Fall semester, admission and award	February 1
Fall semester, admission only	July 15
Spring semester, admission only	December 1
Summer session, 1974* first term	April 15
Summer session, 1974* second term	May 15
Summer session, 1974* third term	June 15

*Students seeking admission to the Graduate School for study in the summer session should make application to the Dean of the Graduate School as well as to the Director of the Summer Session.

Anyone whose folder is not complete before that date will face the possibility that the enrollment in his department will have been filled. While the Graduate School Office will process all applications, it will not guarantee full consideration of a folder for each department after April 15.

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Financial Information

Tuition and Fees

Tuition for all students for a full semester program amounts to $1,170.00 (15 units at $78.00 per unit). Part-time tuition is calculated at the same rate of $78.00 per unit. Tuition charges are due and payable, unless otherwise specified, at the time of registration for that semester and are subject to change without notice. Registration is not considered complete and students may not be admitted to classes until arrangements have been made with the Bursar of the University for the settlement of tuition and fees. A late registration fee of $10.00 is charged any student not completing registration during the registration periods. The *in absentia* fee is due on the date of registration and is subject to the late registration fee if not paid by that date. The fee is $78.00 for 1 unit per semester.

Students passing the preliminary examination may obtain a reduction in their registration and tuition fee at any time during the five-week period beginning on registration day. No other refund in fee may be obtained. A reduction in registration may be made due to changes in departmental service requirements of assistants provided it is made during the first fourteen days after registration and is approved by the Dean. Any fee reduction for this reason is credited to future registration fees. In the event of death, or involuntary withdrawal to enter the armed services, refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition, and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before the beginning of classes: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, and fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

Fees incurred in connection with thesis or dissertation submission are a follows:

*Binding fee, three copies of thesis or dissertation, other copies optional, $5.00 per copy	$15.0
Microfilming fee, doctoral degree only, upon final submission	$25.0
Copyright fee (optional)	$15.0

An athletic fee for the year of $25.00 is optional and payable in the fa semester. The Treasurer of the University has sole responsibility for collectio of fees and for arranging for the proration of fees.

Special Tuition Rates for Teachers and Others. The Graduate Schoo recognizes a special obligation to encourage the following types of students in thei professional and personal advancement: (1) members of the faculties and administrations of the neighboring public schools and colleges, currently engaged i *full-time* school work while taking courses in the Graduate School, (2) minister of neighboring churches, (3) spouses of Duke faculty members, (4) *full-tim* employees of Duke University who are paid on a bi-weekly or monthly basi *throughout* the year and have been employed for one year. The reduced tuitio rates specified below do not apply to teachers and ministers while on leave o absence, nor to holders of fellowships, scholarships, or graduate and researc assistantships, nor to part-time instructors.

Persons eligible for the reduced tuition rate must meet the admissio standards required of all graduate students and must be admitted to the Graduat School. They may enroll for one or two courses per semester (in no case totalin more than 7 units) upon payment of a fee of $5.00 for registration for eac semester and tuition of $39.00 per unit of credit or an audit fee of $40.00 pe course. Residence requirements cannot be fulfilled at the reduced rate. Student enrolled in doctoral (post-master's level) programs are not eligible for the reduced rate.

Fees for Undergraduate Courses. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 unit for a laboratory course.

Audit Fee. In a semester in which a student registers and pays fees for units or more, he may audit one course without charge. Should he be permitte to audit a second course or should he be registered for less than 9 units, th audit fee is $40.00 per course.

Vehicle Fee. Each student possessing or maintaining a motor vehicle a Duke University shall register it at the beginning of the academic year in th Security Office at 2010 Campus Drive. If a student acquires a motor vehicle an maintains it at Duke University after academic registration, he must register i within five (5) calendar days after operation on the campuses begins. Residen students are required to pay an annual fee of $10.00 for each motor vehicle o $5.00 for each two-wheeled motor vehicle. Resident students first registerin after March 1 are required to pay $5.00 for any type of motor vehicle.

At the time of registration of a motor vehicle, the following document must be presented: state vehicle registration certificate; valid driver's license; an satisfactory evidence of automobile liability insurance coverage with limits of at

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*If more than one snap binder is required per copy of the dissertation, a deposit o $3.50 will be collected for each additional snap binder.

east $10,000 per person and a $20,000 per accident for personal injuries, and 5,000 for property damage, as required by the North Carolina Motor Vehicle aw.

If a motor vehicle or a two-wheeled vehicle is removed from the campus ermanently and the decal is returned to the Traffic Office prior to March 1, there vill be a refund of $5.00 for a motor vehicle and $2.50 for a two-wheeled vehicle.

Transcript Fee. A student who wishes to obtain copies of his transcript hould direct requests to the Registrar's Office. A minimum fee of two dollars, ayable in advance, is charged for a single copy. A charge of fifty cents will be nade for each additional copy of the same order.

Debts. No records are released and no student is considered by the faculty s a candidate for graduation until he has settled with the Bursar for all indebtedess.

xpenses

Housing Fee. The charge for each person in a double room for the academic ear is $371.00 in the Graduate Center. The limited number of single rooms are eserved for returning students.

The fee for Town House Apartments is $670.00 each for the academic year n the basis of three students to an apartment. Utilities charges are included in hese fees.

Housing fees are subject to change prior to the 1973-74 academic year. $50.00 deposit is required on all reservations.

No refund on housing fees is made to students who withdraw after the ate of registration, except for those who involuntarily withdraw to enter the rmed services. Such refunds will be made in accordance with the University's stablished schedules.

For further information on housing facilities, see Living Accommodations n the chapter on Student Life.

Food. Food service, on both the East Campus and the West Campus, is escribed under Living Accommodations. The cost of meals approximates $700.00 er year, depending upon the needs and tastes of the individual.

Summary. The following table represents an estimate of a graduate student basic expenses for one academic year for a full program of work. These figure do not include allowances for recreation, travel, clothing, and other miscellaneou items which vary according to personal needs and tastes.

Tuition	$2,340.0
Room Rent (Graduate Center)	371.0
Board	700.0
Laundry	75.0
Books	175.0

Fellowships and Scholarships

James B. Duke Fellowships. The James B. Duke One Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program leading to the Ph.D. degree in the Graduate School at Duke University. Its purpose i to aid in attracting and developing outstanding scholars at Duke. Selection i made by a faculty committee upon nomination by the student's department. Thes fellowships provide for payment of tuition for full registration plus an incom stipend of $290 per month for the first two calendar years and $300 per mont for the academic year during the third and final year. The award requires n service and is renewable each year upon satisfactory progress. The total valu of the award is $5,885 for each of the first two years. The total value of a Jame B. Duke Fellowship over the full three years of tenure is over $14,000. Ther are forty-nine James B. Duke Fellows currently enrolled.

Endowed Fellowships. Other special endowments in addition to the Jame B. Duke Fund provide fellowships for graduate study. There is the Angier B Duke Fellowship which provides for one student supported at the same level a the James B. Duke Fellowships. There are seven Gurney Harris Kearns Fellowships in Religion ranging up to $3,500. Selection for these fellowships is mad through faculty committees.

Graduate Fellowships. Graduate Fellowships funded by Duke University are ailable to students in the departments of the Graduate School for study during e academic year. Stipends range from $2,400 for the academic year to $5,150 r a full calendar year. In 1972-73, there were 78 students holding these fellow- ips.

Federal Fellowships and Traineeships.* Duke University participates in the llowing federal fellowship and traineeship programs:

National Defense Education Act, Title IV Fellowships. The purpose of is program is to encourage and assist graduate students to prepare for careers teachers in the nation's colleges and universities. The fellowships are three- ar awards, with twelve-month stipends of $2,400, $2,600, and $2,800 in the ree years, plus tuition, fees, and dependent's allowance. In 1972-73 there were fellowships. Nominations for these awards originate in the department of ajor study.

National Defense Education Act, Title VI Fellowships. The purpose of is program is to encourage persons to undertake advanced training in modern reign languages and in related area studies not commonly taught in the United ates for the purpose of developing nationwide competence in such languages d the areas in which they are spoken. The world area in which National efense Foreign Language Fellowships are offered at Duke University is Southern sia. In addition to pursuing the normal work toward their degrees, fellows must gage during their tenure in intensive study in a language of the world area. he fellowships carry academic year stipends of $2,000, $2,200, or $2,400, epending on the stage of graduate study, plus tuition and allowances of $500 r each eligible dependent up to four. In 1972-73, six students at Duke Uni- ersity held NDFL Fellowships. Interested persons should obtain a separate ap- lication form from the director of graduate studies in their major department.

National Science Foundation Graduate Traineeships. Through the Na- nal Science Foundation, Duke University makes available graduate trainee- ips to outstanding students who intend to pursue studies in the biological, ysical, and social sciences. Award benefits are stipends of $2,400, first year vel; $2,600, intermediate level; and $2,800, terminal year level for twelve- onth tenure. Benefits also include tuition and dependent's allowances. Ten udents held graduate traineeships in 1972-73. Nominations for traineeships iginate in the department.

Fellowships in Medieval and Renaissance Studies. One fellowship is varded annually by the Duke University Committee on Medieval and Renais- nce Studies. Fellows are chosen from among entering students and receive full ition plus a monthly stipend of $244.00 for nine months. They may request vo renewals of their appointment.

Special Fellowships. The following special fellowships are available to ualified Duke students from sources outside the University:

Shell Fellowships in African Studies. These are available to qualified udents in social sciences who are preparing for careers in the State Department, cluding the foreign services of the United States, the United Nations, or other ternational agencies, or in research and teaching in international affairs in

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*United States citizenship is generally a requirement for eligibility.

academic institutions within the United States. They must be citizens of th United States or are, at present, residing permanently in the United States an intending to become citizens. The fellowships are intended to cover the expens of field research in the preparation of doctoral dissertations. The stipend f each fellowship is $4,000 plus a reasonable amount for transportation expense Inquiries should be made to the Administrative Assistant, Center for Internation Studies, Duke University.

Cokesbury Graduate Awards in College Teaching. These awards are sponsored by the Board of Education of the Methodist Church. They are designed t assist graduate students who are committed to a Christian philosophy of highe education and who intend to teach in college. The applicant must have been member of the Methodist Church for at least three years, and must have bee accepted for or currently be pursuing a program of graduate studies at one o the Methodist-related universities, including Duke University, approved for thi program. Awards for one year vary in amount from $500 to $2,500. Application must be completed before February 1. Further information and applicatio forms may be obtained from the Dean of the Graduate School.

Exchange Fellowships with the Free University of Berlin. These fellowships are available through an exchange arrangement with the Free University o Berlin which will provide fellowships for two graduate students to work durin the regular academic year in Berlin. Departments will submit nominations to th Dean of the Graduate School before February 1.

Departmental Fellowships. Various departments and schools in Duk University have fellowships which are available to students pursuing appropriat studies. Departments should be consulted for further information.

Graduate Scholarships. Graduate Scholarships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Awards are for full or partial payment of tuition and range in value to $2,340. In 1972-73, 81 students held Graduate Scholarships.

Summer Scholarships. A small number of Summer Scholarships which provide a payment of $400 are available to students who are engaged in full-time study during the summer session. Interested students should consult their director of graduate studies.

Assistantships

Graduate Assistantships. Appointments as graduate assistants carry a total stipend up to $4,530 for the academic year. The value of the stipend is determined by the fraction of time given to assisting, the qualifications of the assistant, and the nature of work assigned. In 1972-73, 174 students held Graduate Assistantships.

Research Assistantships. Appointments are for predoctoral candidates whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to $4,380 depending on the assisting time required. In 1972-73, 137 students held Research Assistantships.

Part-time Instruction. Several departments offering graduate work make use of exceptionally qualified graduate students as part-time instructors, tutors, and teaching assistants. These students are usually able to register for a graduate program of 9 units a semester.

Payment of Awards

The payment of stipends to graduate students holding awards starts on September 30 and is made in nine equal monthly payments on the last working day of each month thereafter. The Controller of the University has sole responsibility for paying all stipends to students.

Ordinarily stipends awarded under fellowships and scholarships are not subject to income and Social Security tax. However, a portion of the award to graduate assistants and research assistants may be subject to both. The Graduate School Office will supply detailed information.

Loans

Interested students of good academic standing may apply for Duke University loans either under the National Defense Education Act or from Duke University sources. These loans usually bear lower rates of interest than commercial loans. Application should be made to Mr. W. O. Petty, Jr., 108 East Duke Building, Duke University, Durham, North Carolina 27706.

Because University loan funds are not large enough to handle the number of requests, students are encouraged to inquire concerning loan possibilities with the Higher Education Assistance Corporations in their home states, or with a lending institution near the student which may be a participant in the Federal Guaranteed Loan Program. Low interest loans under this program have provisions similar to those sponsored by the National Defense Education Act.

7

Registration and Regulations

Registration

Who Must Register. All students must register (1) who enter course work or residence for credit; (2) who have completed minimum requirements for an advanced degree, but continue to use the facilities of the University in their research; (3) who have *in absentia* status; or (4) who wish merely to audit a course or courses.

Registration Periods. After receiving notification of his or her admission to the Graduate School and returning a statement of acceptance of admission, the student may register at the first scheduled registration period. During the registration periods, announced in this *Bulletin*, the student first confers with the director of graduate studies of his or her major department who prepares and signs a course card listing the course work to be taken during the semester. The student then presents this course card to registration officials for enrollment in the selected courses. After a student's first registration he or she must register for subsequent semesters at the regular, stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration. *Former students* who intend to register to resume a degree program must give the department and the Dean notice of this intention two months before registration.

Late Registration. All students are expected to register at the times stated in this *Bulletin*. A late registration fee of $10.00 is charged to all students registering late, including current students who, (1) delay registering until the special registration for new students or, (2) must register *in absentia*.

Change of Registration. During the academic year within a period of *two weeks* from the day of registration, registration may be changed with the approval of the director of graduate studies if no reduction in fee is entailed, or if fees are to be refunded, only with the approval of the Dean. For the succeeding two weeks, the only permissible change is dropping course-seminar registration and adding equivalent units of research, with the approval of the director of graduate studies, the instructor of the course, and the Dean. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

Academic Regulations

Residence.* Although graduate study consists principally of individual reading, research, and laboratory experimentation under guidance, academic progress in the United States is generally measured and recorded in terms of course hours and credits. Credit for courses and seminars, research, and residence, and corresponding tuition and fees are stated in terms of units. One unit is equivalent to one semester hour. The term *residence* designates full-time study and research in close proximity to the facilities provided, as opposed to part-time study incidental to a full-time occupation. For purposes of satisfying the residence requirement of the various degrees, residence of one year is defined as two successive academic semesters of no less than 9 units registration each semester. (See the chapter on Graduate Study in the Summer Session for residence required of master's candidates engaged solely in summer study.)

Course Load. A graduate student is considered fully registered when he enrolls for the number of credits his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in fulfilling his degree requirements. In the academic year normal registration for the *resident doctoral* student who does not hold an appointment as part-time instructor or assistant or does not engage in part-time work is 15 units a semester or 30 units an academic year. The normal registration for the *resident doctoral* student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties. The resident doctoral student carries such normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units a semester until the dissertation is accepted. If he elects to go out of residence, he registers for 1 unit a semester *in absentia* in order to keep his program active.

The resident student engaged in a master's program requiring a thesis registers as though he were a resident doctoral student. However, once he has completed all requirements except the thesis, he may reduce his registration to the 3 units per semester, *provided he is not proceeding to doctoral work at Duke*. If he decides to go out of residence, he registers for 1 unit *in absentia*. Regulations pertaining to a resident student engaged in a master's program requiring no thesis are identical to those described above for the doctoral student up to and including the semester in which his course requirements are satisfied. At that point, he may reduce his registration to the number of hours necessary for completion of his degree program.

In each term of the summer session 6 units is maximum registration. Students who are in residence during the academic year and wish to continue study and the use of University facilities including Student Health during the summer ust register for one unit in the first summer session term. This registration pro- ides use of these facilities for all three terms of the summer session.

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*See also section on Program Information.

The registration of 1 unit a semester *in absentia* provides occasional consul- ation with the thesis or dissertation supervisor. It may be waived for military uty or serious problems of health. Except in the semester in which a final exam- ation is scheduled, every student is allowed two semesters of *in absentia* egistration without fee provided that the student is a master's degree candidate ho has completed his course and language requirements or is a doctoral candi- ate who has passed his preliminary examination. The student qualifying must egister at the proper time each semester as *in absentia-no fee*. The student who kes advantage of this provision while completing a master's program may not gain use it should he proceed into a doctoral program.

It is necessary to be a fully registered student according to the regulations sted above in order to establish eligibility for library carrel and laboratory space. udent housing, University and some outside loans, and Student Health Service including accident and sickness insurance; see page 41).

Credits. The following regulations pertain to credits earned outside of the uke University Graduate School:

Graduate Credit Earned before the A.B. Degree is Granted. Ordinarily o credit will be allowed for graduate courses taken before a student has been warded his A.B. or B.S. degree. However, an undergraduate student at Duke niversity, who at the beginning of his final semester lacks no more than 9 emester hours of fulfilling the requirements for the A.B. or B.S. degree, may btain permission from the Dean of the Graduate School to enroll for graduate ourses sufficient to bring his total program to 15 hours a week. Such graduate ourses will be credited toward the A.M., M.S., M.B.A., M.Ed., or M.A.T. degree, rovided that the student meets the requirements for admission to the Graduate chool, and that he is duly registered in the Graduate School at the beginning of he semester in which he intends to earn graduate credit.

Transfer of Graduate Credits. Credit for graduate course work earned at nother institution will be determined only after a student has spent one semester t Duke University. After completing his first semester, the student should file a equest, approved by his director of graduate studies, that his credits be reviewed nd a decision be made.

Graduate Credit for Courses Taken in the School of Law. Upon the rec- mmendation of the director of graduate studies, and upon the approval of the ean of the Graduate School, students in the social sciences may take certain ourses in the School of Law for graduate credit. In some instances courses in he School of Law may be considered as fulfilling a student's requirements for elated work. To register for such courses, the student should present a letter rom his director of graduate studies to the Dean of the School of Law requesting ermission to register for certain specific courses.

Reciprocal Agreements with Neighboring Universities. Under a plan of ooperation between Duke University and the University of North Carolina at hapel Hill, North Carolina Central University in Durham, and North Carolina tate University at Raleigh, students properly enrolled in the Graduate School f Duke University during the regular academic year, and paying full fees to his institution, may be admitted to a maximum of two courses per semester t one of the institutions in the cooperative plan. Such students are required to pay a nominal registration fee of $2.00 and any other special fees regularly r quired of all students. Under the same arrangements, students in the gradua schools in the neighboring institutions may be admitted to course work at Duk University. All inter-institutional registrations involving extra-fee courses will b made at the expense of the student and will not be considered a part of the Duk University tuition coverage.

Grades. Grades in the Graduate School are as follows: *E, G, S, F,* and *E* (exceptional) is the highest mark; *G* (good) and *S* (satisfactory) are the re maining passing marks; *F* (failing) is below passing; and *I* (incomplete) indicate that some portion of the student's work is lacking, *for an acceptable reason,* a the time the grades are reported. The instructor who gives an *I* for a cours specifies the date by which the student must have made up the deficiency, in n case more than one calendar year from the date the course ended. If the cours is not completed, the grade of *F* is normally entered upon the student's recor The grade of *Z* indicates satisfactory progress at the end of the first semester c a two-semester course. It will be changed to whatever grade is appropriate upo the completion of the course. A grade of *F* in a major course normally occasion withdrawal from a degree program not later than the end of the ensuing semeste or term; a grade of *F* in any other course occasions academic probation.

Courses Primarily for Undergraduates. Students granted provisional ad mission and others whose preparation is found deficient may on occasion b required as part of their program to take undergraduate courses as prerequisite to continued graduate study. Undergraduate courses thus taken and others electe by the student will carry no graduate credit.

In exceptional cases, 100-level courses *outside the major department* ma be taken for graduate credit to a maximum of two one-semester courses or on year-course not exceeding a total of 8 units, when approved by the director o graduate studies in the major department and in the department in which th course is listed, and by the supervisor of the program. In order to receive credi for any such undergraduate work, the graduate student must earn a grade o at least *B*. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course

Withdrawal from a Course. For permissible changes during the first fou weeks after the registration date, see Change of Registration. If a course is dropped without the necessary approval, the permanent record will list the course as *Dropped Unofficially, F.* If a course is dropped after the four-week period, the status of the student at the time of withdrawal from the course will be determined and indicated on the permanent record as *Withdrew Passing (WP)* or *Withdrew Failing (WF).*

Interruption of Program and Withdrawal from the Graduate School. The University reserves the right, and matriculation by the student is a concession of this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the University. If a student wishes for any reason to withdraw from the Graduate School, he should notify both the director of graduate studies in his major department and the Dean of the Graduate School prior to the date of his expected withdrawal. (For refunds upon withdrawal, see the section on Tuition and Fees. For withdrawal occasioned by academic failure, see above.)

Students who find it necessary to interrupt their program of study for a period longer than a summer vacation should, before departure, leave with the Graduate School Office a statement of the reason for interruption, mailing address, and expected date of return. If they are subject to registration *in absentia,* they should arrange for such registration before departure.

A foreign student who after successfully completing a minimum of one semester's graduate study must withdraw for the purpose of returning home before the completion of a graduate program may with the approval of his major department request the Dean to issue him a Certificate of Graduate Study.

Size and Make-up of Classes. Classes which carry graduate credit are limited in size to thirty students. In exceptional cases this regulation may be modified, but only by permission of the Dean of the Graduate School. Courses numbered from 200 through 299 may have not only graduate students enrolled but also an unspecified number of sophomores, juniors, and seniors, provided the undergraduates have the approval of both the course instructor and the director of graduate studies. Undergraduate students are not permitted to enroll in 300-level courses.

Language Requirements. Although individual departments have the right to establish their own minimal requirements (see individual departmental headnotes in this *Bulletin*), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. may be waived in individual cases or with respect to all students in a given department, provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the students concerned. The languages normally taken are French, German, and Russian. A student may substitute for any one of these another language which has a definite relation to his degree program and for which an examination can be provided. A foreign student whose native language is not English may request that the director of graduate studies in his department ask permission of the Dean of the Graduate School to offer English for the foreign language required in his program. (See calendar at the beginning of this *Bulletin* for the scheduled dates of the appropriate examination in English.)

To avoid unnecessary delays, prospective students should anticipate the language requirement of their degree programs. For example, students whose programs call for a knowledge of French, German, Russian, or Spanish are urged to take the appropriate ETS Graduate School Foreign Language test prior to registration. It should be noted, however, that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language examinations more than six calendar years old will not be accepted toward fulfilling the language requirement.

Meeting the Requirement. The foreign language requirement may be satisfied in the following ways:

1. The student may take one of the Educational Testing Service examinations administered to undergraduate and graduate students at many national centers (including the Duke University Counseling Center). The examination may be taken no longer than six years before the preliminary examination.
2. With the permission of the Dean of the Graduate School, the director of graduate studies may request transfer acceptance of a language examination

passed prior to the student's enrollment at Duke. The student should request that a transcript or other certification that the language was passed be sent to the Graduate School for approval. The limitations are that *(a)* only one language of a doctoral requirement may be met in this way, *(b)* the other institution offers a doctoral program in the student's major and the examination would have met a doctoral requirement there, and *(c)* the examination was passed no more than five years before first registration here.

3. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

4. In special circumstances, a reading examination in any foreign language may be administered by a qualified member of the faculty under a procedure specified by a department and approved by the Dean and the Executive Committee of the Graduate Faculty.

Requirements for Foreign Students. Foreign students whose native language is not English are, during their first registration period, required to take a test for minimum competence in English. Such students, with the approval of the director of graduate studies in their major department, may request permission of the Dean of the Graduate School to substitute English for the one foreign language required in the master's or doctoral program. If permission is granted, *an additional* advanced-level reading test in English will be arranged. (See Admission Procedure for Foreign Students.)

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week; French during the fall semester and occasionally also in the spring, German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register in the summer with permission of the Dean of the Graduate School, provided total registration permits.

Undergraduate Language Courses. Students whose programs require them to take elementary language courses numbered below 200 receive no graduate credit for the work so taken.

Standards of Conduct

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, from time to time, are put into effect by the appropriate authorities of the University.

Judicial Code and Procedures. In the spring, 1971, the Graduate School Community ratified and adopted the following official judicial code and procedures:

I. Graduate School Judicial Code and Procedures

A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates his willingness to subscribe to and be governed by the rules and regulations of the University as currently in effect, or, from time to time, put into effect by the appropriate authorities of the University, and he indicates his willingness to accept disciplinary action, if his behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies the responsibilities that are his in relation to civil authorities and laws.

B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in his major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.

C. Actions which appear to conflict with University-wide rules and regulations will fall under the jurisdiction of the University Judicial Board.

D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or he may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in his major department. (The constitution and procedure of the judicial board are detailed below under "The Graduate School Judicial Board.")

E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

II. The Graduate School Judicial Board

A. *Composition.* The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student himself.

B. *Preliminary Procedures.* If a student requests a hearing by the Judicial Board he must do so in writing, allowing its chairman at least 72 hours to convene the Board. In addition, the chairman shall not convene the Board until 72 hours after he has been asked to convene the Board.

It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board. In addition, he shall prepare a written summary of this information for the Board, the Dean, and the student.

C. *Procedural Safeguards for the Hearing.* The Accused has the right to challenge on the grounds of prejudice any member of the Judicial Board. If the Board decides to excuse one or more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements.

The Accused may choose an Advisor to assist him in his defense. He may also produce witnesses (including no more than two character witnesses), introduce documents, and offer testimony in his own behalf.

A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance.

The Accused has the right to examine the written statement of any witness relevant to his case at least 72 hours before the hearing. He has the right to be faced by any witness who has given a statement relevant to his case at the hearing if the witness's attendance can be secured.

The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing, the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

D. *Conduct of the Hearing.* The hearing of any case shall begin with a reading of the charge by the chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying it in part.

The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify his plea or to modify its charge.

Pending verdict on charges (including appeal against the Accused, his status as a student shall not be changed, nor his right to be on campus or to attend classes suspended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by his conduct, that his continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

E. *Sanctions and the Verdict.* The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; Suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; Disciplinary Probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; Restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties.

The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote.

The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

F. *Appeals.* The appellant may submit to the Dean a written statement containing the grounds for his appeal and his arguments. In such cases, the Dean should determine if the appeal should be granted, and he can hear the case himself, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the Accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards"; new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

III. Amendment and Construction

This Judicial Code and Procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.

8

Study in the Summer

Programs Offered

The 1973 Summer Session of Duke University will consist of three terms. The first term will begin on May 14 and will end on June 15. The second term will begin on June 18 and will end on July 20. The third term will begin on July 23 and will end on August 24.

Graduate students who wish to work toward advanced degrees in the summer session, particularly in chemistry, economics, education, English, history, mathematics, religion, sociology, and zoology, will find a selection of courses offered by members of the Duke faculty and by visiting professors. Other departments ordinarily offering work leading to the A.M. degree are Botany, Political Science, and Psychology. Thesis research for advanced graduate students is available also in most other departments, such as Engineering, Forestry, and Physics.

Students who wish to be admitted to the Graduate School for work in the summer session should make application to the Dean of the Graduate School, as well as to the Director of the Summer Session, and should return the completed application, with supporting documents, before April 15 for admission to Term I; before May 15 for admission to Term II; and before June 15 for admission to Term III. (See the section on Admission.)

Regulations Regarding Summer Work

No graduate student may register for more than 6 units of credit in one summer session term. All of the work required for the master's degree must be completed within six years of the date of matriculation. No residence credit can be accepted toward the requirement for the Ph.D. degree for work completed during the summer sessions. Students who complete during the summer session the work required by the University for an advanced degree will be granted the degree in September.

The *Bulletin of the Summer Session* containing information about graduate courses may be obtained by writing to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.

9

Courses of Instruction

Course Enrollment

In general, courses with odd numbers are offered in the fall semester, those ith even numbers in the spring semester. Double numbers separated by a hyphen ndicate that the course is a year course and must normally be continued throughout e year if credit is to be received. A student must secure written permission from e instructor in order to receive credit for either semester of a year course. Double umbers separated by a comma indicate that although the course is a year course, redit may be received for either semester without special permission. Normally, ourses which bear no date are offered every year.

Note: In each department the number 399 is reserved to designate special individual) readings in a specified area and supervised by a regular member of e graduate staff, with credit of one to three units each registration, only one ourse per registration, and nine units maximum in three successive registrations. he course is restricted to resident master's and doctoral programs, must have a mpletion exercise, and must carry a grade.

Anatomy

Professor Robertson, *Chairman* (Room 466, Sands Building); Assistant Professor Adelman, *Director of Graduate Studies* (Room 369, Sands Building); Professors Buettner-Janusch, Everett, Moses, and Peele; Associate Professors Counce, Duke, Longley, and Reedy; Assistant Professors Bergeron, Blake, Cartmill, Erickson, Hall, Hylander, Johnson, Mahaley, Reynolds, and Shafland

The Department of Anatomy offers graduate programs designed to produc teachers and research workers competent in a broad range of anatomical science: both A.M. and Ph.D. degrees are offered. Students with a wide variety of bacl grounds and interests in the biological sciences can be accommodated. All studen participate in a core anatomical sciences course (Anatomy 301) and gain experienc in teaching over the range of departmental interests. Students are encouraged t round out their formal course work by drawing upon the offerings of other depar ments in the University, as well as those in the Anatomy Department. Laboratorie within the department are equipped for and actively support research in severa areas. Some idea of the opportunities for degree research may be gleaned from th description of Anatomy 312. For further information contact the Director of Graduate Studies.

207. Human Anatomy. A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurc logic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, an reproductive systems. The course includes cadaveric presentations of every majo region of the human body. Intended primarily for students in allied health prc grams. Prerequisite: permission of instructor. Credit variable; maximum 3 units *Blake and Staff*

208. Anatomy of the Trunk. Designed for Ph.D. candidates in anatom as well as general practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisite core course in anatomy. Number of students arranged by staff. 2 units. *Duke*

210. Introduction to Human Structure. Based on the dissection of cadaver. Emphasis upon the biological and evolutionary aspects of human morphology. There is a strong emphasis upon comparative morphology in the course Prerequisite: permission of instructor. Hours and credit by arrangement. Offere spring, 1974, and alternate years thereafter. *Shafland*

216. Anatomy of the Head and Neck. A study in detail of the genera organization of head and neck. Emphasis on individual dissection, clinical implications, and phylogenetic continuities. Prerequisite: Anatomy 301. Minimur enrollment—8; maximum—20. 2 units. *Shafland and Hylander*

219. Molecular and Cellular Basis of Development. A multidisciplinar approach stressing the molecular, cellular, and genetic processes involved in development and differentiation in pro- and eukaryotes. Topics include: initiatio of development, morphogenesis, developmental genetics, differentiation, and nuclear-cytoplasmic interactions in development. (Also listed as Biochemistry 219 Microbiology 219, Pathology 219, and Physiology 230.) 3 units. *Counce, Johnson, McCarty, Luftig, Padilla, and Sommer*

219S. Seminar. Optional seminar offered in conjunction with Anatom 219. Students prepare and present seminar topics directly related to specific subject discussed in Anatomy 219. Prerequisites: enrollment in Anatomy 411 and permission of instructors. 1 unit.

231. Human Evolution I. Evolutionary biology of the primates. Anatomical behavioral, and molecular adaptations of fossil and living primates including *Hom sapiens*. Prerequisite: a course in biology or consent of instructors. (Also listed a Anthropology 231 and Zoology 131.) 3 units. *Buettner-Janusch and Cartmill*

232. Human Evolution II. Human population and biochemical genetics. nalysis of the effects of natural selection on past and present human populations. rerequisite: Anatomy 231 (Anthropology 231, Zoology 131), consent of instruc- r, or a course in genetics. (Also listed as Anthropology 232 and Zoology 132.) units. *Buettner-Janusch*

236. Human Genetics. Particular emphasis upon the uniqueness of studies human biochemical and population in genetics. Prerequisite: Anatomy 231 nthropology 231, Zoology 131), or an elementary course in biology including enetics, or permission of instructor. (Also listed as Anthropology 236 and Zoology 36 and under the University Program in Genetics.) 3 units. *Buettner-Janusch*

238. Function and Evolutionary Morphology of Primates. History and unctional significance of locomotor and feeding adaptations, craniofacial morph- logy, sense organs, and reproductive systems in primates, including *Homo sapiens.* rerequisite: Anatomy 231 (Anthropology 231, Zoology 131) or equivalent, or onsent of instructor. (Also listed as Anthropology 245.) Spring, 1975, and lternate years thereafter. 3 units. *Hylander and Cartmill*

246. The Primate Fossil Record. The evolution of man and his relatives n the order *Primates* as inferred from the fossil remains of their extinct ancestors. rerequisite: Anatomy 231 (Anthropology 231, Zoology 131) or equivalent or ermission of an instructor. Spring, 1974, and alternate years thereafter. (Also listed s Anthropology 246.) 3 units. *Cartmill and Hylander*

261. History of Generation and Mammalian Reproduction. Theories of eneration and of historical development of present-day concept of mammalian eproductive processes. Prerequisite: consent of instructor. Offered fall, 1973, and lternate years thereafter. (Alternates with Anatomy 263.) 1 unit. *Duke*

263. History of Anatomy. The lives and contributions of the founders of natomy, Aristotle to the twentieth century. Prerequisite: consent of instructor. ffered fall, 1974, and alternate years thereafter. (Alternates with Anatomy 261.) unit. *Duke*

264. Mammalian Embryology and Developmental Anatomy. Study of arly embryology and organology of mammals, using the rat as the basic form, upplementing it with other mammalian forms, including primates. Prerequisites: ne year of zoology and consent of instructor. 4 units. *Duke*

266. Topics in Cell Structure and Function. Advanced discussions of elected problems such as chromosome structure, mitosis, and cytological aspects of nheritance and development. Prerequisites: Zoology 160 or Zoology 260 or quivalent and permission of instructor. (Alternates with Anatomy 288 and Zoology 88.) (Also listed as Zoology 266.) Offered spring, 1974, and alternate years hereafter. 2 units. *Moses and Nicklas*

271. Comparative Neurology and Psychology. Variations among brains f different vertebrate species will be correlated with genetic lines of descent and he behavioral requirements of different habitats. Prerequisite: permission of in- ructor. (Also listed as Psychology 271.5.) 3 units. *Hall*

280. Molecular Basis of Anatomy. Lectures and conferences on the mo- ecular structure of biological macromolecules and their organized aggregates such s are found in viruses, muscles, membranes, and other intracellular organelles, ith emphasis on the results of electron microscopy, X-ray diffraction, and optical analysis. Prerequisites: microscopic anatomy or cytology (or equivalent) and pe mission of instructor. Offered spring, 1975, and alternate years thereafter. (Alte nates with Anatomy 286.) 3 units. *Longley, Adelman, Erickson, Moses, Reed and Robertson*

***284. Tutorial in Developmental Biology.** Reading and discussion pr gram to be arranged to suit the individual student's interests in the field. Pr requisite: permission of instructor. Limit: 5. Credit variable. *Counce*

286. Optical Methods in Biophysical Cytology. Theory and application biophysical techniques for investigating cell structure and function: fundament of optics; qualitative and quantitative analysis using ordinary, ultraviolet, phas interference, polarization, and fluorescence microscopy, and transmission and sca ning electron microscopy; optical, electron, and X-ray diffraction; autoradiograph Prerequisites: microscopic anatomy or cytology (or equivalent), calculus and o year each of physics and general chemistry; permission of instructor. Offer spring, 1974, and alternate years thereafter. (Alternates with Anatomy 280.) units. *Longley, Erickson, Moses, Reedy, and Robertson*

***288. The Cell in Development and Heredity.** A seminar on topics current interest and controversy. Prerequisites: a course in genetics and permissi of instructor. (Alternates with Anatomy 266 and Zoology 266.) (Also listed Zoology 288 and under the University Program in Genetics.) 2 units. *Counce a Gillham*

290. Membrane Structure. Theories of membrane structure and histo of their development; physical and chemical structure of membranes; lipid-prote and lipo-protein models. Electron microscopic, X-ray diffraction, and polarizati optical studies of membrane structure considered in detail. Enrollment: minimum 1 unit. *Robertson*

291. Special Topics in Nerve Ultrastructure. Each student chooses topic, such as ultrastructure of synapses, or sensory nerve endings including t retina, of auditory nerve, of simple nerve nets, or morphological correlates of lear ing. Each student pursues his topic in the library during the first half of the semest with guidance from the instructor in order to prepare a detailed paper. The secon half of the semester is devoted to seminar presentations and discussions of the s lected topics. Enrollment: minimum 5. 2 units. *Robertson*

300. Gross Anatomy. Gross anatomy for physical therapy students. Cred to be arranged; maximum—8 units. *Blake and Staff*

301. Gross Human Anatomy, Microscopic Anatomy, and Neuroanatom Gross anatomy includes complete dissection of a cadaver; laboratory work is su plemented by conferences which place emphasis upon biological and evolutiona aspects. Microscopic anatomy will emphasize the cell, its generalized structur and functional organization down to the molecular level, and differentiations the cell in various organs and tissues. Students will be introduced to light a electron microscopic and diffraction methods for investigating biological structur Neuroanatomy will first present the gross and basic intrinsic anatomy of the centr nervous system. Later, specific systems will be emphasized: various sensory a motor; limbic-hypothalamic; and cerebral-associated mechanisms. Clinical pr sentations will be offered. Prerequisites: adequate background in biology, includi comparative anatomy and embryology, and written permission of the Director

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* Not offered spring, 1974.

Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Hours and credit by arrangement; maximum—8 units. *Staff*

303. Neuroanatomical Basis of Behavior. A study of the gross and microscopic anatomy of the nervous system with emphasis on the structural and funcional relationship between tracts, nuclei, and cortical areas. 3 units. *Hall and Peele*

312. Research. Individual investigations in the various fields of anatomy. Laboratories in which a student may work include: three electron microscopy aboratories headed by Moses, Reedy, and Robertson with emphasis respectively on the fine structure and cell biology of chromosomes and associated structures, molecular structure and function of muscle, and biophysical studies of the cell membrane and nervous tissue; physical anthropology laboratory and Primate Facility nder Buettner-Janusch, Bergeron, Cartmill, and Hylander, concentrating on molecular genetics, cytogenetics, comparative anatomy, and primate evolution and behavior; neuronanatomy laboratories under Peele and Hall emphasizing structural orrelates of behavior and learning; neuroendocrinology laboratories under Everett and Blake with emphasis on brain mechanisms regulating reproductive functions of the pituitary gland; a human reproduction laboratory under Duke studying ovarian structure and function; developmental biology laboratories under Counce and Johnson with emphasis on insect and amphibian morphogenesis and the relaionships of cell membrane contact phenomena to differentiation; a physical biohemistry laboratory under Reynolds investigating protein-amphipile interactions nd molecular organization; a cell biology laboratory under Adelman emphasizing biochemical aspects of primitive motility and the structure and function of membranes; a comparative anatomy laboratory under Shafland studying feeding mechanisms in lower vertebrates; and molecular structure laboratories under Erickson and Longley using a combination of electron microscopy, X-ray diffracion, and optical and computer methods of image analysis. Credits to be arranged. Permission of staff required. Maximum—6 units. *Staff*

313, 314. Anatomy Seminar. Regular meeting of graduate students and taff in which current research problems in anatomy will be presented. 1 unit per emester. *Staff*

331, 332. Primate Seminar. Detailed examination of the literature on he Primates. Systematics, genetics, behavior, field studies, morphology, and paleontology are the major topics. Museum and live specimens will be examined at he Primate Facility. Given fall and spring, 1973-74, and alternate years thereafter. Alternates with Anatomy 333 and Anatomy 334.) Prerequisite: consent of intructor. 3 units per semester. *Buettner-Janusch and Staff*

333. Primate Evolution. Phylogeny of the order Primates, inferred from he fossil record, from molecular biology, and comparative anatomy of living primate populations. Hominid paleontology. Prerequisite: consent of instructor. (Also isted as Anthropology 333 and Zoology 333.) Given fall, 1974, and alternate years hereafter. (Alternates with Anatomy 331.) 3 units. *Buettner-Janusch and Cartmill*

334. Topics in Physical Anthropology. Reading and discussion of recent research. Prerequisite: Anatomy 333 (Anthropology 333 and Zoology 333). (Also isted as Anthropology 334 and Zoology 334.) Given spring, 1975, and alternate years thereafter. (Alternates with Anatomy 332.) 3 units. *Cartmill and Buettne Janusch*

340. Tutorial in Advanced Anatomy. Topics for intensive reading an discussion will be chosen according to the student's interests, related to basi problems in biophysics, cytology, endocrinological control, growth and develop ment, neuroanatomy, physical differentiation, and evolutionary origins of function micro-systems. Maximum enrollment—8. Prerequisite: permission of instructo 3 units. *Staff*

344. Advanced Neuroanatomy of Sensory and Motor Mechanisms. Th course will involve consideration of classic and modern concepts of somatic an special sensory systems and of somatic and visceral motor systems. Clinical correl tions of basic neuroanatomy will be included. Minimum enrollment—5; max mum—20. 3 units. *Peele*

354. Research Techniques in Anatomy. A preceptorial course in variou research methods in anatomy. An interested student might engage in research i one of the following: anthropology, electron microscopy, developmental biolog fetal physiology, primate behavior, primate anatomy, and stereotactic approache to neuroendocrinology and neuroanatomy. Other topics may be arranged. Prerequisite: permission of instructor. Units to be arranged. *Staff*

403. Endocrinology and Reproduction. Current concepts of biosynthesis secretion, and mechanisms of action of hormones. Structural relationships an endocrine regulation at cellular, organ, and higher integrative levels. Structure an function of male and female reproduction systems including hormonal mechanism in pregnancy and parturition. (Also listed as Physiology and Pharmacology 403. Enrollment minimum—8. 3 units. *Everett, Fellows, and Anderson*

Anthropology

Associate Professor Fox, *Acting Chairman* (344 Sociology-Psychology Building) Assistant Professor O'Barr, *Director of Graduate Studies* (341 Sociology-Psychology Building); Professor LaBarre; Associate Professor Apte; Assistant Professors Cartmill, Casson, Hylander, and Quinn; Instructor Kress

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Recor Examination Aptitude Test.

Candidates for the Ph.D. degree must demonstrate a general competence i four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more o these sub-fields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the cours work required for the Ph.D. by advanced work in anatomy, economics, psychology sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program in anthropology, the departmenta facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies for Anthropology, Department of Anthropology.

For Seniors and Graduates

220. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. 3 units. *Fox and Apte*

222. Topics in African Anthropology. Current research problems in African anthropology, illustrated by a study of tribal societies, in terms of contemporary theories. 3 units. *O'Barr*

231. Human Evolution I. See course description for Anatomy 231. (Also listed as Anatomy 231 and Zoology 131.) *Buettner-Janusch and Cartmill*

232. Human Evolution II. See course description for Anatomy 232. (Also listed as Anatomy 232 and Zoology 132.) 3 units. *Buettner-Janusch*

236. Human Genetics. See course description for Anatomy 236. (Also listed as Anatomy 236, Zoology 236, and under the University Program in Genetics.) 3 units. *Buettner-Janusch*

240. Indo-Aryan Linguistics. Historical development of Indo-Aryan languages from Sanskrit to the modern period. A comparative analysis of modern Indo-Aryan languages as regards phonology, morphology, syntax, and lexicon. Impact of non-Indo-Aryan languages on the structure and lexicon of Indo-Aryan languages. Prerequisite: Anthropology 118 or permission of instructor. 3 units. *Apte*

243. Seminar in Theory and Method in Archaeology. In-depth study of modern archaeological methods stressing geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses. These techniques will then be applied to problem areas in archaeology—human cultural origins, lower- to mid- and mid- to upper-paleolithic, post-Pleistocene readaptations, origins of agriculture and civilization. 3 units. *Kress*

245. Functional and Evolutionary Morphology of Primates. See course description for Anatomy 238. 3 units. *Hylander and Cartmill*

246. The Primate Fossil Record. The evolution of man and his relatives in the order Primates, as inferred from the fossil remains of their extinct ancestors. Prerequisite: Anatomy 231 (Anthropology 231, Zoology 131) or equivalent, or permission of instructor. 3 units. *Cartmill and Hylander*

249. Economic Anthropology. Economic organization and behavior in pre-literate, peasant, and transitional societies; analysis of ownership and distribution. The relationship of economic processes to norms and institutions such as markets. 3 units. *O'Barr and Quinn*

250. The Anthropology of Cities. The organization and behavior of men in cities are analyzed from an evolutionary perspective on the development of urban centers. The objective is a cross-cultural analysis of the nature of cities and their varying roles within the societies in which they occur. 3 units. *Fox*

259. Linguistic Anthropology: Language Acquisition. Biological basis of human linguistic capacity, major theoretical positions in linguistics, acquisition of semantics, syntax and phonology in English and other languages. Prerequisite: permission of the instructor. 3 units. *Casson*

260. Linguistic Anthropology: Phonemics. Application of linguisti theory to analysis of language; concentration on the sound system of non-Wester languages. Prerequisite: Anthropology 118 or permission of the instructor. 3 units *Apte and Casson*

261. Linguistic Anthropology: Morphology and Syntax. Application o linguistic theory to analysis of language; concentration on the grammatical system of non-Western languages. Prerequisite: Anthropology 118 or permission of th instructor. 3 units. *Apte and Casson*

262. Anthropology of Law. Legal decision in pre-literate societies. Th interrelationships of law and ritual. 3 units. *Staff*

263. Primitive Art and Music. A comparative ethnological study of th data and theories concerning non-European music and art; sufficient technica background will be provided for non-specialist students. Recordings, slides, an museum artifacts will be used. 3 units. *LaBarre*

264. Primitive Religion. The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. 3 units. *LaBarre*

265. Personality and Society. The developmental social psychology o human personality, its origin in the primary group, its nature and varieties and it integrations into secondary group institutions. Prerequisite: permission of the instructor. 3 units. *LaBarre*

266. Personality and Culture. The influence of culture patterns and socia institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comparative anthropological materials will be draw upon. Prerequisite: permission of the instructor. 3 units. *LaBarre*

270. Seminar in Ethnographic Field Methods. Focus on preparation fo and conduct of field research. Examination of research strategies and technique for data collection as well as participation in a field project in a local community 3 units. *O'Barr*

271. Seminar in Methods of Data Analysis. Quantitative analysis o anthropological data. 3 units. *Quinn*

274. Statistics Methods in Anthropology. Statistical analysis of anthropological data. Emphasis on the special problems of sampling, data scaling, an hypothesis testing which face anthropologists. Examples illustrating uses, misuses and limitations of statistics in anthropology. 3 units. *Quinn*

275. Rank, Power, and Authority in Pre-Industrial Societies. Study o the role and development of social, economic, and political distinctions betwee men. A general perspective on social stratification from the sociological and anthropological literature will be presented, and then analyzed in relation to specifi ethnographic examples drawn from Oceania, Africa, and the New World. Prerequisite: concentration in anthropology or graduate standing. 3 units. *Fox*

276. Analysis of Kinship Systems. Primitive relationship categories a related to legal norms and social groupings. Theoretical issues and contrastin approaches to the analysis of social classification terminologies. 3 units. *Casso*

278. Special Topics in Political Anthropology. Current research problems n political anthropology. Topic(s) will change each semester. 3 units. *O'Barr and Quinn*

280, 281. Seminar in Selected Topics. Special topics in methodology, theory, or area. Prerequisite: permission of the instructor. 3 units per semester. *Staff*

291, 292. Anthropological Theory. Theoretical, methodological, and comparative issues in anthropology. 3 units per semester. *Fox*

For Graduates

330, 331. Seminar in Anthropology. A seminar for advanced students who wish to pursue individual studies in social and cultural anthropology. Offered both emesters. 1 to 3 units per semester. *Staff*

333. Primate Evolution. See course description for Anatomy 333. (Also isted as Anatomy 333 and Zoology 333.) 3 units. *Buettner-Janusch and Cartmill*

334. Topics in Physical Anthropology. See course description for Anatomy 334. (Also listed as Anatomy 334 and Zoology 334.) 3 units. *Buettner-Janusch nd Cartmill*

335, 336. Linguistic Theory and Methods. Basic course for graduate students in the anthropology graduate program. 3 units. *Apte and Casson*

393. Individual Research in Anthropology. A course for the student preparing the A.M. thesis or the Ph.D. dissertation. Supervision and guidance of intensive research on a problem approved by the student's departmental advisory ommittee. 3 units. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

410. Seminar in the Government, History, and Social Structure of India nd Pakistan. 3 units. *Fox and Staff*

Art

Professor Covi, *Chairman and Director of Graduate Studies;* Professors Hall, Heckscher, Jenkins, Markman, Mueller, and Sunderland; Lecturer Langedijk

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required o attend prescribed undergraduate courses. A reading knowledge of one foreign anguage (preferably German) is required; candidates who do not meet this equirement upon admission to the program are expected to do so by the end of heir first term in residence.

The program for the A.M. degree in art history consists of 30 units, as ollows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis required. The candidate must also pass a written comprehensive examination testir his knowledge of art history and pertinent bibliographical resources.

217. Aegean Art. A study of the problems of Aegean art as the forerunn of Greek art and in relation to the contemporary civilization of the eastern Med terranean world. 2 units. *Markman*

218. Early Greek Art. A study of the problems of the origin and develo ment of Greek art in the Geometric period to the end of the Archaic. 3 unit *Markman*

***233. Early Mediaeval Architecture.** The development of religious arch tecture from the time of Constantine to the end of the First Romanesque style i the third quarter of the eleventh century. 3 units. *Sunderland*

***234. Romanesque Sculpture.** The development of sculpture in Wester Europe from the early Christian period through the culmination of Romanesque a in the west portal of Chartres Cathedral. 3 units. *Sunderland*

237. French Renaissance Art. Sixteenth century painting and sculptur in France with special emphasis on Italian influences. Prerequisites: some know edge of Italian Renaissance art and the ability to read French; or consent of th instructor. 3 units. *Jenkins*

238. Sienese Painting. Painting in Siena in the late Middle Ages and th Renaissance. Open to majors in history of art or by consent of the instructor. units. *Jenkins*

239. Architecture of Britain. A summary of recent archaeological activit in the British Isles and a survey of mediaeval building, the course deals principall with changing architectural problems and their solutions from the advent of th Renaissance onward. Attention is given to the interests of students majoring i history or literature. 3 units. *Hall*

240. Architecture of North America. A study illustrating the transplanta tion of European architectural customs since the sixteenth century; the time-la in transit and acceptance of later European developments; the gradual assumptio of confident independence in design; and the emergence of international leaders i the United States. 3 units. *Hall*

241. Problems in Latin American Art. The architecture, painting, sculp ture, and other arts with the emphasis on colonial architecture of Central America Open to students who have a reading knowledge of Spanish and/or have ha courses in Latin American history, economics, or literature. 3 units. *Markman*

247. Problems in the History of Graphic Arts. Concentrated study o selected topics in the history of prints and drawings. 3 units. *Mueller*

248. Studies in Florentine Painting. Painting in Florence during th Renaissance. Prerequisite: Art 137 or 138 or consent of instructor. 3 units. *Cov*

251-252. Research. A course designed to give instruction in methods usec in the investigation of original problems. Open to seniors by permission of th Director of Undergraduate Studies. 6 units. *Heckscher*

* Offered upon demand.

253. Studies in Italian Renaissance Sculpture. 3 units. *Covi*

255, 256. Iconological Problems. Study of subject matter and sources. units each semester. *Langedijk*

291, 292. Museology Seminar. Operation of a museum; instruction in xhibition and restoration techniques, as well as registration and the researching of rt objects with a view to exhibition accompanied by scholarly catalogues. Open o art majors or by consent of the instructor. 3 units each semester. *Heckscher nd Staff*

293, 294. Special Problems in Art History. Individual study and research. units each semester. *Staff*

399. Directed Reading and Research. 1 to 3 units. *Staff*

Asian Languages

The course is offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced underraduate students. No major work is offered in Hindi-Urdu.

Hindi-Urdu 200-201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized raded work in cognate South Asian languages necessary for the advanced student ontemplating field work in South Asia. Prerequisite: consent of instructor. 6 units. *taff*

For offerings in Chinese and Japanese, see *Bulletin of Undergraduate Instruction.*

Biochemistry

Professor Hill, *Chairman* (Medical Sciences Building); Professor Gross, *Director f the Genetics Division* (Medical Sciences Building); Professor Kirshner, *Director f Graduate Studies* (Medical Sciences Building); Professors Fridovich, Guild, Handler,* Kamin, McCarty, and Tanford; Associate Professors Appel, Greene, Harris, Kaufman, Lynn, Rajagopalan, Sage, and Webster; Assistant Professors Bell, Habig, Hall, Harriman, Kelley, Kim, Kredich, McKee, Reynolds, Richardson, Siegel, Sullivan, and Wheat; Associates Bittikofer, Bonaventura, McCord, Nozaki, nd Steinman

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Underraduate majors in chemistry, biology, mathematics, or physics are welcomed, but dequate preparation in chemistry is essential. Graduate specialization areas include protein structure and synthesis, enzyme action, and metabolism. The Division f Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research nd study to fulfill the requirements for the Ph.D. degree.

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* On leave of absence.

204. Introductory Genetics. An introduction to genetic analysis wit emphasis on the molecular basis of mutation, segregation, function, and organiz tion of the genetic material. Primarily for medical students, but graduate student may be admitted with the instructor's permission. (Also listed under the Universit Program in Genetics.) 3 units. *Gross and Others of the University Program i Genetics*

208. Laboratory Methods in Biochemistry. An advanced laboratory cours that emphasizes current procedures, instrumentation, and experiments. Each st dent selects from a number of experiments a wide range of classical investig tions that illustrate significant biochemical progress. Prerequisites: Biochemistr 293, 295, and 297, or equivalent. Offered only in the summer. 2 units. *Staff*

209-210. Independent Study. A tutorial designed for students who ar interested in either a laboratory or a library project in biochemistry. Units to b determined. *Staff*

216. Molecular Genetics. An advanced course on genetic mechanisms an their relationship to nucleic acids. Prerequisites: introductory courses in biochem istry and genetics. (Also listed under the University Program in Genetics.) 3 units *Guild and Others of the University Program in Genetics*

219. Molecular and Cellular Basis of Development. See course descrip tion for Anatomy 219. (Also listed as Anatomy 219, Microbiology 219, Patholog 219, and Physiology 230.)

219L. Laboratory. Optional laboratory offered in conjunction with th lecture. Techniques of organ and cell culture, chromosome morphology, and som electron microscopy as applied to development and differentiation will be presented 2 units. *McCarty, Luftig, Bolognesi, Graf, Harris, Johnson, and Kaufman*

219S. Seminar. Optional seminar offered in conjunction with Biochemis try 219.

222. Protein Crystallography. Introduction to the techniques of structur determination by single-crystal X-ray crystallography and study of some macro molecules whose three-dimensional structures have been determined at hig resolution. 2 units. *Kim and Richardson*

241. General Biochemistry. An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure an functions of special tissues. For medical students and graduate students only wit permission of instructor. 4 units. *Staff*

247. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, and nucleic acids and the metabolic interrelationships of these compounds The biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction, and muscle contraction will also be considered. Prerequisites: Chemistry 151 one year of college physics (second semester may be concurrent), Mathematics 22, or consent of the instructors. This course is acceptable in partial fulfillment o the departmental major requirements in biochemistry, botany, chemistry, an zoology. (Listed also as Zoology 248.) 3 units. *Webster and Sage*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polynorphism, natural selection, and protein structure, and comparison of homologous roteins and nucleic acids. Laboratory work involves the purification and characerization of homologous proteins from fish and invertebrates. Techniques used inlude salt fractionation, electrophoresis, ion-exchange and molecular exclusion hromatography, fingerprinting, molecular weight determination, amino acid comosition, and other related approaches. Prerequisite: consent of the instructor. Also listed as Zoology 276.) (Given at Beaufort.) 6 units. *Sullivan*

282. Experimental Genetics. A series of laboratory exercises and discusions on the molecular mechanisms of mutation, recombination, replication, trancription, and translation of the genetic material. May be taken concurrently with Genetics 280. Prerequisite: consent of instructor. (Also listed under the University Program in Genetics.) 2 units. *Harriman and Others of the University Program n Genetics*

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in esponse to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed under the University Program in Genetics.) 1 unit. *Hall and Others of the University Program in Genetics*

286. Current Topics in Immunochemistry. The structure, function, and specificity of antibodies. Immunogenicity and tolerance with special emphasis on current theories of the diversity and synthesis of antibody molecules. 2 units. *Sage*

288. The Carbohydrates and Lipids of Biological Systems. The subjects will be considered in the following two general categories: (*a*) the relationship between chemical structure and biological function, and (*b*) biosynthesis and catabolism. 2 units. *Kaufman*

290. Bioenergetics. Biological mechanisms of transduction of energy (covalent, ionic, photonic, and electric) will be considered, using photosynthetic, oxidative, phosphorylative, and glycolytic systems as examples. Since many of the above processes occur in membranous systems, the role and function of membranes in these processes will also be considered. 2 units. *Lynn*

293. Macromolecules. The structures of biological macromolecules and their relations to biological functions. The emphasis is on proteins and enzymes. Prerequisites: physical chemistry equivalent to Chemistry 161-162. 4 units. *Hill, Kim, Richardson, and Tanford*

294. Nucleic Acids and Macromolecular Synthesis. Physical properties of nucleic acids in terms of covalent structure, helix, base pairing, helix-coil transitions, as well as properties that influence fractionation by techniques of column-fractionation, velocity and equilibrium centrifugation, etc., and are considered in relation to biological function. Protein nucleic acid interactions, as well as damage, repair, and mechanisms of synthesis will be reviewed. Mechanisms of RNA transcription and enzymatic alterations of preformed macromolecular structures will be illustrated by recent examples. Protein synthesis and polypeptide bond formation is considered in terms of initiation, decoding, translocation, ribosomes, termination, and release. 3 units. *McCarty and Staff*

295. Enzyme Mechanisms. A study of current views of the modes of action of enzymes and of the techniques which are found most useful in elucidating these matters. Theory and practice will be given equal emphasis. 3 units. *Fridovich and Rajagopalan*

296. Biological Oxidations. A lecture, conference, and seminar cours which deals with the mechanism of electron transport and energy conservation in variety of oxidative enzymes. These mechanisms will be examined both in purifie enzymes and in organized systems such as the mitochondrion, the endoplasmi reticulum, and the chloroplast. 2 units. *Kamin, Fridovich, Rajagopalan, and Sieg*

297. Intermediary Metabolism. The synthesis and degradation of carbo hydrates, lipids, proteins, and nucleic acids will be discussed in detail with emphasi on energy transformation and metabolic interrelationships. 3 units. *Kirshner an Siegel*

298. Regulation of Cellular Metabolism. The metabolic, hormonal, an genetic parameters involved in regulation of the metabolic activities of the cell ar surveyed with emphasis on patterns of regulation. Selected regulatory mechanism are considered in detail. Prerequisites: Biochemistry 295 and 297 or permission o instructor. 2 units. *Greene and Staff*

345, 346. Biochemistry Seminar. Required of all biochemistry students 1 unit per semester. *Siegel and Staff*

351, 352. Genetics Seminar. Required of all students specializing i genetics. (Also listed under University Program in Genetics.) 1 unit per semester *Harriman and Others of the University Program in Genetics*

390. Biochemistry of Membranes. Physical and chemical properties o biological membranes, and their relation to properties of constituent lipids an proteins and membrane function. Prerequisite: Biochemistry 293 or its equivalent 2 units. *Bell, Reynolds, and Tanford*

395. Biochemical Pharmacology. (For description, see Physiology an Pharmacology 395.) 2 units.

Botany

Professor Wilbur, *Chairman* (149 Biological Sciences Building); Associate Professor Strain, *Director of Graduate Studies* (136 Biological Sciences); Professors Anderson, Billings, W. Culberson, Hellmers, Johnson, Kramer, Naylor, Philpott. and Stone; Associate Professors Antonovics, Barber, Boynton, Knoerr, Searles. and White; Assistant Professor Blankley; Lecturer C. Culberson

Graduate work in the Department of Botany is offered leading to the A.M. and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

203. Cytogenetics. Organization and variation in chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. Laboratory optional, but limited to 12 students. 3 units. *Anderson*

203L. Laboratory in Cytogenetics. Techniques for chromosomal preparaions for light microscopy. Mitotic and meiotic interpretations, determination of hromosome numbers and karyotypic comparisons. Ordinarily to accompany Botany. 203. 1 unit. *Anderson*

205. Anatomy. Intensive survey of vascular plant cell types, tissues, and organs, with emphasis on the modern application of anatomy to problems of systematics and phylogeny. Laboratories will include microtechnique. Special project and term paper stressing current techniques and literature required. Prerequisite: permission of instructor. 4 units. *White*

S205. Introductory Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. (Summer session only.) 6 units. *Blankley*

209. Lichenology. Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. 3 units. *W. Culberson and C. Culberson*

210. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. 3 units. *Anderson*

S211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. (Summer session only.) 6 units. *Searles*

212. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. 4 units. *Searles*

221. Mycology. Field and laboratory study of the vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in the local flora. Prerequisite: one year of biological science. 4 units. *Johnson*

225, 226. Special Problems. Students with adequate training may do special work in the following fields. Credit to be arranged. 1-4 units.

1. Cytology; Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Lichenology. *Culberson*
7. Physiology. *Hellmers*
8. Bacteriology; Mycology. *Johnson*
9. Physiology. *Kramer*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics and Taxonomy of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

242. Systematics. A general survey of the principles of vascular plan taxonomy, with practice in identification and collection. Lectures, laboratories, an field trips. Prerequisite: one year of biology. 4 units. *Wilbur*

245. Plant Diversity. An examination of the major groups of the livin plants and a consideration of their evolutionary origins and phylogenetic relationships. 4 units. *Culberson and White*

246. Ecology. Intensive study of the environmental effects on growth an distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. *Billings or Strain*

248. Introductory Biochemistry. (See course description for Biochemistr 247.) (Also listed as Biochemistry 247 and Zoology 248.) 3 units. *Webster an Sage*

250. Plant Biosystematics. Analysis of the basic descriptive and experimental procedures used in the study of plant evolution. Prerequisites: introductor courses in anatomy, genetics, and systematics. 4 units. *Stone*

251. Physiology. Physiological processes in plants and their interrelationships. Lectures, laboratories, and readings. Prerequisite: permission of instructor. 4 units. *Hellmers*

252. Plant Metabolism. The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. 4 units. *Naylor*

254. Plant-Water Relations. A study of factors affecting the availabilit of water, its absorption and movement through plants, and the effects of water deficits on plant processes. Prerequisite: Botany 151 or equivalent. 3 units. *Kramer*

255. Plant Systematics. A survey of the principles of plant taxonomy. Prerequisite: Botany 52 or equivalent. 4 units. *Wilbur*

257. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisite: Botany 156 or equivalent. 3 units. *Billings*

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Prerequisites: Botan 151 or equivalent; organic chemistry is recommended. 4 units. *Naylor*

259. The Environment. Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 156 or equivalent. 3 units. *Billings*

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 151 and 156 or equivalents. 4 units. *Strain*

266. Analysis and Classification of Vegetation. The concepts and methods of synecology; modern approaches with a review of historical aspects. Prerequisite: Botany 156 or equivalent. 4 units. *Strain*

280. Principles of Genetics. Introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Zoology 280 and under the University Program in Genetics.) 3 units. *Antonovics, Boynton, and Gillham*

285. Population Genetics and Evolution. For a description of the course, see the University Program in Genetics. 2 units. *Antonovics and Staff*

359-360. Research in Botany. Individual investigation in the various fields of botany. Credits to be arranged. *All Members of the Graduate Staff*

The University Program in Genetics. Genetics courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this *Bulletin* under the University Program in Genetics for description of the offerings.

204, Introductory Genetics; 215, Bacteriophage: Structure and Function; 216, Molecular Genetics; 236, Human Genetics; 280, Principles of Genetics; 282, Experimental Genetics; 284, Current Topics in Genetic Mechanisms; 285, Population Genetics and Evolution; 336, Immunogenetics; 351-352, Genetics Seminar.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in this *Bulletin* in the chapter Special and Cooperative Programs.

The University Program in Marine Sciences. Interdisciplinary programs emphasizing marine botany are available. Refer to the announcement in this *Bulletin* under Marine Sciences—The University Program.

Business Administration

Professors Baligh, Keller, and Volpp; Associate Professors Battle, Burton, Dellinger, Laughhunn, and Pondy; Assistant Professors Aldrich, Damon, Hagerman, Kuhn, Maier, and Petersen

The Graduate School of Business Administration offers work leading to the M.B.A., Ph.D., and the M.S. in Management Sciences. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate for rigorous analysis. Normally, undergraduate majors in such fields as the physical and biological sciences, mathematics, engineering, and the social sciences are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The doctoral level course work presumes either a Duke M.B.A. or the equivalent.

For information on the M.S. in Management Sciences, see page 94.

All 200-level courses in the Department of Management Sciences are open to graduate students from other departments. They are listed in the *Bulletin of Undergraduate Instruction*.

MASTER OF BUSINESS ADMINISTRATION

First Year Courses (Required)

300-301. Managerial Theory of the Firm. Classical economic theory and its further developments into more advanced, modern, and useful forms as elements of the fundamental theory of the firm are the subjects of this course. Major emphasis is on the theory of competitive price and non-price market behavior in single and multiple market segments, inventory and production planning, capital investment decisions, introductory concepts of cooperation for exchange (i.e., vertical production and marketing relationships), and formulation of the basic economic strategy of the firm. 5 units semester I and 4 units semester II.

310. Foundations for Quantitative Analysis I. Considers mathematical structures which are useful models for subsystems of an economic enterprise. The structures considered provide the framework for understanding and analyzing complex organizations and economic events, and develop problem-solving tools and techniques. This course provides the mathematical and statistical background beyond beginning calculus required in the M.B.A. program. Major topics are: sets, relations, and functions; introductory probability theory; linear algebra; classical optimization techniques; and introduction to linear programming. 5 units.

311. Foundations for Quantitative Analysis II. Continuation of B.A. 310. The major topics are: probability, statistical decision theory, sampling theory, estimation and hypothesis testing, and regression and correlation analysis. 4 units.

320. Management of Information and Control Systems I. The financial accounting model is developed as a critical subset of the general information system of the firm. This initial model is extended through consideration of general systems theory to encompass the economic and organizational models of the firm developed in B.A. 300 and 330. 3 units.

321. Management of Information and Control Systems II. The classical cost accounting model is developed and then restructured to provide data for planning and control of complex enterprises through use of modern managerial technology. This includes design of an information system that provides the data needed for advanced economic and organizational models of the firm. 3 units.

330, 331. Organization Theory and Management. The first semester of this course is concerned with the analysis of purposive behavior in complex organizations. Theories of individual decision-making, human aspects of groups, and normative and descriptive systems are the major areas of concern. The second semester continues the work but emphasizes the firm as a social-political system. Strategy concepts, motives for collective activity, goal setting, and policy formulation are the primary topics. The course ends with an overview of the executive function within the administrative system. The purpose of the course is to provide the future administrator with an understanding of human behavior in groups and formal organizations particularly as that behavior deviates from and extends Business Administration 300-301. In addition, the course provides the behavioral theories and findings necessary for treating the firm as an information-processing, problem-solving system in Business Administration 320-321. 3 units per semester.

341. Macroeconomic Analysis. The economic theory pertaining to the economy of the nation is developed in this course. The determinants of price level, rate of growth, and level of aggregate income, employment, and output are studied with emphasis on understanding the rationale of government policies and the impact of governmental behavior on these variables. 2 units semester II.

Second Year Courses—Fall Semester (Required)

The purpose of the work in the third semester of the M.B.A. program is to provide advanced tools of analysis and a general framework of understanding within which those tools can be applied. The relationships among the parts of the firm and the relationships between the firm and the various sectors of its environment can be classified into those which are competitive and those which are cooperative. (Obviously, the relationships between any two organizations are likely to contain both competitive and cooperative aspects.) The work in this semester is focused on more advanced analysis of how the firm's internal relationships and actions are related to the firm's external relations and actions. Since the legal framework is closely related to these matters, an introduction to some aspects of the law is included. Prerequisites for this set of courses are the courses in the first-year M.B.A. program.

302. Cooperative Decisions and Competitive Strategies. Problems of choosing cooperative economic relations in order to effect exchange transactions, and the problems of determining competitive behavior. The efficiency and stability of various forms of cooperative vertical market structures under simple competitive conditions are rigorously studied. Competitive market decisions are studied in the context of the formulation and solution of purely competitive market games. Although the more advanced and rigorous portions of the course are mathematical and theoretical, increasing emphasis is focused on the practical applications to markets and the development of realistic combinations of cooperative and competitive programs. 4 units.

303. Cooperative-Competitive Relations and Decisions. The firm's decisions on its cooperative and competitive behavior and on the design of its internal structure and its production and financial operations are treated simultaneously in the models of this course. The subject of the course is the firm's coordinated treatment of the decision variables which reflect its direct relations to those economic units with which it cooperates and competes to effect exchange transactions, and those which relate to the form of its internal operations and organizational structures. 2 units.

312. Operations Research. Mathematical models of various aspects of economic operations are developed and solved, including topics in the areas of queuing, inventory, and maintenance. General procedures for the solution of mathematical problems involving the identification of maxima and minima are studied along with simulation and the use of the computer for the generation of solutions. 4 units.

332. Organization Design and Internal Operations. The design organizations for coordination and control of the internal operation is studied. The topics include: (*a*) specialization, both functional and hierarchical, with particular attention to the problems of decomposition and decentralization; (*b*) coordination, including benefit/cost analyses of alternative means of coordination; and (*c*) control, with emphasis on the role of information systems and the design of decision rules. These topics are examined for the organization in general, but with specific references and application to the production and finance segments. 4 units.

349. Law as a Constraint for Business. The major laws that specify the rules within which the firm must operate, including some aspects of the commercial code, anti-trust law, labor and fair employment law, the most significant regulatory agencies, and court cases that assist in understanding the application and interpretation of the law are studied. 2 units.

Second Year Courses—Spring Semester

This final semester of the M.B.A. program is oriented to bring to application the foundations built during the first three semesters. Hence, the bulk of the work in this semester is directed toward understanding and solving problems of the firm, using the tools of analysis and the conceptual framework developed earlier. The only specifically required courses are Business Administration 350 and 390.

350. Public Policy of the Firm. This course is focused on analysis of the relationships between the firm and the three segments of society: the public at large, the organizations and individuals in close contact with the firm, and the members or employees of the firm. Primary emphasis of the other parts of the M.B.A. program is on design and decision-oriented to reach the goals of the firm. This course treats some of the problems involved in selecting the ends and restraints from among feasible alternatives: i.e., the problems of developing a policy of the firm toward the society of which it is a part. 3 units.

390. The Practicum. The practicum is individually designed and is a major component of the second-year program designed to give the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of the real situation and the explicit formulation of the problem. That is, the problem which the student treats in the practicum should not be described with only the solution left to be developed. The important task of identifying and specifying the actual problem, perhaps after being directed to correct some undesirable symptoms, is an integral part of the practicum.

The practicum report should propose a solution to the problem specified and should contain the explanation and logic that supports those recommendations. This solution should be one that can be implemented and must not ask for human or nonhuman resources unavailable for use in the proposed solution. Further, where the solution of the problem is sensitive to the assumptions made, those assumptions must be realistic. The practicum is supervised by one of the two professors teaching the electives selected by the student. 5 units.

313. Advanced Operations Research. Emphasis on application of dynamic and stochastic models and less on static and deterministic models and on the strategic design and control of more complex, multi-unit activities leads to formulation of operations research models and modification of existing models for new and novel problem situations. 4 units.

323. Controllership. The focus of this course is on developing systems for collecting and summarizing data in a manner which meets the requirements of the management team in its function of controlling and planning operations of the firm. The function of the controller, as the center for synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters of the program. 4 units.

324. External Reporting and Auditing. This course builds on the information systems sequence of the first year and the public policy course, Business Adninistration 350, in terms of developing requirements of the system for reporting o parties, external to the firm, who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of nd attesting to the reliability of data will be studied in detail. 4 units.

333. Manpower Planning and Management. An application of behavioral nd economic theories and of quantitative techniques to management of the firm's uman resources, including treatment of both labor and management personnel. Detailed examination of American occupational structure (e.g., mobility patterns, ncreasing specialization, and professionalization) and analysis of the labor union s an institution are included. Topics studied within the constraints of industrial nd labor institutional structure are: employee testing, selection and assignment, raining and development, performance evaluation and optimal incentive systems, trategic and tactical factors in collective bargaining. 4 units.

351. Finance. The management of the financial affairs of the firm in its attempt to develop an optimal capital structure includes the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 4 units.

353. Marketing. An application of the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involves a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 4 units.

355. Production. The purpose is to give the student experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered: the design (or planning) of manufacturing systems and their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods, and processes and facilities planning. Sub-topics under operation include cost, inventory, and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 4 units.

DOCTOR OF PHILOSOPHY

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, one course in philosophy of science, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

309.1-.9. Research in Managerial Economics. 1 to 6 units.

319.1-.9. Research in Quantitative Methods. 1 to 6 units.

329.1-.9. Research in Information and Accounting Systems. 1 to 6 units.

339.1-.9. Research in Organization Theory and Management. 1 to 6 units.

348.1-.9. Research in Public Policy and Social Responsibility. 1 to 6 units.

352.1-.9. Research in Finance. 1 to 6 units.

354.1-.9. Research in Marketing. 1 to 6 units.

356.1-.9. Research in Production. 1 to 6 units.

391.1-.3. Supervised Independent Research. This is to allow students in the M.B.A. program who are judged not to need required courses to do more advanced work. 1 to 5 units.

392-393. Tutorial in Interdisciplinary Areas. 1 to 6 units.

397. Dissertation Research. 1 to 6 units.

MASTER OF SCIENCE IN MANAGEMENT SCIENCES

300. Managerial Economics. Development of the fundamental theory of economic enterprise and use of that foundation in the analysis of economic operations. Theories of production, demand, and market behavior are developed to examine transformation and transaction operations of the firm. Emphasis is on optimum solutions to problems of internal efficiency and on design of cooperative and competitive strategies for the economic enterprise. 4 units.

302. Planning and Internal Organization. Short-run planning with emphasis on linear economic models and long-run planning with emphasis on capital budgeting models. Design of internal structure and management information systems for planning, implementation, and control. 4 units.

310. Mathematics for Management. Mathematics for optimization with and without constraints in linear and nonlinear systems. Topics include partial derivatives, LaGrange multiplier, Kuhn-Tucker conditions, matrix algebra, and linear programming. 4 units.

311. Probability and Statistics. Foundations of probability theory and statistical decision theory. Topics include: events, random variables, distributions, expectation, independence, functions of random variables. Central Limit Theorem. Bayes Law, elementary utility theory, sequential decision problems, use of experiments in decision problems, and an introduction to classical statistical inference. 4 units.

312. Operations Research. The development of quantitative models for analysis of management decision problems. Topics include postoptimality analysis of linear programming, network analysis, game theory, dynamic optimization models, and queuing theory. Several of these techniques are applied to the analysis of inventory problems. 4 units.

320. Organization Analysis and Operation Design. Analysis of organizations, emphasizing functional operations and design of the organization structure. Topics include determination of organization structure, the mechanisms of coordination, the requirements of information, the design and use of decision rules, the choice of a partitioning scheme for the organization, the mechanisms of control, and the interaction among them. 4 units.

330. Accounting and Control Systems. Use of accounting data for planning, evaluating, and controlling activities of the enterprise. Special consideration is devoted to the requirements for data in the models and methods useful in modern forecasting, planning, and control. 4 units.

340. Controllership. The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units.

341. Marketing Management. Analysis of the firm's general market competitive and cooperative strategy problem. Specific problem areas include pricing, product and product line design, promotion, logistics, and research, and the relationships among these various problem areas and their solutions. 4 units.

342. Financial Management. Sources and uses of financial resources for the firm are examined. Capital budgeting, cash management, and the mix of external financing are examined in the context of attempts to achieve the optimal capital structure of the firm. 4 units.

343. Production Management. Design of manufacturing systems, operating rules, and policies. Included are: choice of technology, design of the physical system, development of operating procedures and decision rules for scheduling, inventory and cost control, quality assurance, and the interaction of manufacturing with other functions of the firm. 4 units.

344. Human Resource Management. The design of plans and policies for effective and efficient management of the firm's human resources. Emphasis is placed on the development of policies for training, selection, compensation, and career planning which are consistent with the overall mission of the firm and with the firm's production, marketing, and financial policies. Some attention is devoted to discussion of the possible conflicts and trade-offs between corporate objectives and the welfare of individual members of the firm. 4 units.

350. Social Issues and the Complex Organization. Examination of issues that arise because market competition does not produce the effects demanded by society. Areas considered include: regulation of competitive activities, buyer protection, fair employment and labor relations, environmental protection, and social incentive for economic action. The effect of "self-regulation" and of "governmental regulation" are compared. 4 units.

390. Practicum. A major project in which the student selects a problem of an economic organization and develops its solution. Normally the problem is from the organization of which he is a part, and the problem is a specific case of the general area represented in the elective selected for concurrent registration. 4 units.

Chemistry

Professor Quin, *Chairman* (101 Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (329 Gross Chemical Laboratory); Professors Bradsher, Brown, Hobbs, Jeffs, Krigbaum, Parham, Poirier, Smith, Strobel, and Wilder Associate Professors McPhail, Palmer, and Wells; Assistant Professors Baier Baldwin, Crumbliss, Gutknecht, Henkens, Lochmüller, and Porter; Adjunct Professor Peterlin; Adjunct Associate Professors Ghirardelli, Pitt, Rosenthal, and Spielvogel

In the Department of Chemistry graduate work is offered leading to the A.M and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

For Seniors and Graduates

201. Molecular Spectroscopy. The theory and application of selected spectroscopic methods to the study of molecular structure. Topics include symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra, with examples drawn from both inorganic and organic chemistry. 3 units. *Staff*

203. Quantum Chemistry. An introduction to the basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundations of quantum theory. A major emphasis is placed on the application of molecular orbital theory to organic and inorganic systems. 3 units. *Staff*

205. Structure and Reaction Dynamics. A study of structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Particular emphasis will be placed on the use of kinetic techniques to solve problems in reaction mechanisms. 3 units. *Staff*

207. Principles of Thermodynamics, Diffraction, and Kinetics. Basic principles of thermodynamics, kinetics, and diffraction, with applications to important chemical problems. 3 units. *Staff*

240. Chemical Oceanography. For course description, see Zoology 240. (Also listed as Zoology 240.) Given at Beaufort. 6 units. *Staff*

For Graduates

300. Basic Statistical Mechanics. Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Emphasis on systems of weakly interacting particles with internal degrees of freedom. 3 units. *Staff*

302. Basic Quantum Mechanics. The fundamentals of quantum mechanics with special emphasis on chemical applications. Topics included are: linear algebra, the uncertainty relations, angular momentum, perturbation theory and time dependent phenomena, molecules in electromagnetic fields, group methods, and electron correlation. 3 units. *Staff*

303, 304. Special Topics in Physical Chemistry. Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction, application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins, group theory, intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aerosols, physical-chemical methods of polymer characterization, structure and bonding in metalloenzymes, statistical mechanics of fluids, topics in structural chemistry, and triplet excitons. 1 to 3 units per semester. *Staff*

310. Theoretical and Structural Inorganic Chemistry. An advanced study of theoretical concepts and structural determination techniques as applied to inorganic systems. Areas included are crystal field and ligand field theories, magnetic susceptibility, and electronic, infrared, and Raman spectroscopy. 3 units. *Crumbliss and Palmer*

312. Inorganic Reactions and Mechanisms. Chemistry of main group and transition elements. Emphasis on current developments in synthetic and mechanistic studies of inorganic, organometallic, and organometalloid compounds. 3 units. *Crumbliss and Wells*

313, 314. Special Topics in Inorganic Chemistry. Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Examples of topics which may be discussed are bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 3 units per semester. *Staff*

320. Synthetic Organic Chemistry. A study of the scope and limitations of the more important types of reactions in synthetic organic chemistry. Some discussion of the rapidly developing use of transition metals, complex hydrides, and photochemistry will be included. 3 units. *Baldwin, Bradsher, and Parham*

322. Organic Reactive Intermediates. A discussion of reactive intermediates in organic chemistry. Topics will include carbanions, carbenes, carbonium ions, free radicals, photochemical excited states, and other reactive species. 3 units. *Porter and Wilder*

323, 324. Special Topics in Organic Chemistry. Advanced topics and recent developments in the field of organic chemistry. Each year heterocylic chemistry or the chemistry of natural products will be among the topics presented. Lectures, and written and oral reports. 1 to 3 units per semester. *Staff*

330. Chemical Separation Methods and Kinetics in Analytical Chemistry. The principles of rate processes and diffusion; plate-theory, adsorption and chemical selectivity. Thermodynamics of processes leading to differential migration in chromatography. Kinetic methods of analysis with emphasis on the quantitative determination of concentration in biological and non-biological systems. 3 units. *Staff*

331, 332. Special Topics in Analytical Chemistry. An advanced treatment of important areas in modern analysis. Possible topics include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 3 units per semester. *Staff*

334. Chemical Instrumentation and Applied Spectroscopy. Principles of instrumental design. Topics covered include input transducers, dispersive devices, servo systems, operational amplifiers, and digital logic. An introduction to advanced topics in analytical spectroscopy. Fourier transform methods in infrared and n.m.r.

spectroscopy, X-ray fluorescence, applications of lasers to high-speed measurements, and fast-scan spectrophotometry. 3 units. *Staff*

373, 374. Seminar. Required of all graduate students in chemistry. On hour a week discussion. 1 unit per semester. *All Members of the Graduate Sta*

375, 376. Research. The aim of this course is to give instruction in methods used in the investigation of original problems. Individual work and conferences 1 to 6 units. *All Members of the Graduate Staff*

377. Research Orientation Seminar. A survey of departmental research Required of all entering graduate students in chemistry. Prerequisite: permissio of the Director of Graduate Studies. 1 unit. *All Members of the Graduate Sta*

Classical Studies

Professor Oates, *Chairman* (325 Carr); Professor Newton, *Director of Graduat Studies* (326 Carr); Professors Richardson, Truesdale, and Willis; Associat Professor Stanley; Assistant Professors Burian, Nixon, and Rigsby

The Department of Classical Studies offers two programs leading to the Ph.D degree, one with emphasis on literature and philology, the other with emphasis o ancient history and archaeology. For regular admission to the program in literature and philology, a student must offer three years of college study above th elementary level in one of the classical languages and two college years in th other. Students wishing to enter the program in ancient history and archaeolog will be required on entrance to demonstrate satisfactory competence in both Gree and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficienc

The department's special requirements in addition to the general requirement of the University for the Ph.D. degree set forth in the section on Program Information of this *Bulletin* are presented in a sheet that may be obtained from the Directo of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates fo the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

GREEK

For Seniors and Graduates

200. Graduate Reading. 3 units. *Truesdale*

203. Homer. The *Iliad* and *Odyssey;* The problem of language and structure in the epic; present state of Homeric scholarship. 3 units. *Stanley*

***205. Greek Lyric Poets.** Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. 3 units. *Truesdale*

***206. Aeschylus.** The *Oresteia,* with study of the form of *Agamemnon* and its place in the design of the trilogy. 3 units. *Willis*

***208. Sophocles.** The Theban plays; the structure and style of Sophoclean tragedy. 3 units. *Willis*

* Not offered in 1973-74.

209. Euripides. Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. 3 units. *Stanley*

***210. Aristophanes.** Origin and development of Greek comedy; representative plays of Aristophanes. 3 units. *Truesdale*

***221. Early Greek Prose.** Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. 3 units. *Truesdale*

***222. Thucydides.** The History; Thucydides' historical method and style. 3 units. *Willis*

***223. Greek Orators I.** Early fourth-century rhetoric, including Andocides, Lysias, and Isocrates. 3 units. *Willis*

***224. Greek Orators II.** Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth-century political history and rhetorical development. 3 units. *Willis*

***225. Plato.** Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. 3 units.

***231. Hellenistic Poetry.** The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. 3 units. *Stanley*

241. Advanced Prose Composition. Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. 1 unit. *Willis*

For Graduates

(At least two of these are offered each year.)

301. Greek Seminar I. 3 units.

302. Greek Seminar II. 3 units.

303. Greek Seminar III. 3 units.

304. Greek Seminar IV. 3 units.

305. Greek Seminar V. 3 units. *Stanley*

306. Greek Seminar VI. 3 units. *Oates*

311. Proseminar in Papyrology. 3 units. *Willis*

313. Proseminar in Greek Epigraphy. 3 units. *Willis*

321. Seminar in Literary Papyri. 3 units. *Willis*

323. Seminar in Documentary Papyri. 3 units. *Oates*

399. Directed Reading and Research. Variable credit. *Stanley*

LATIN

For Seniors and Graduates

200. Graduate Reading. 3 units. *Newton*

* Not offered in 1973-74.

***201. The Verse Treatise.** The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura,* Vergil's *Georgics,* and Ovid's *Ars Amatoria;* attention to Cicero's *Aratea,* the *Astronomica* of Manilius, Horace's *Ars Poetica,* and Ovid's *Fasti.* 3 units. *Newton*

***202. Roman Satire.** A survey of the genre, with concentration on Horace, Juvenal, and Persius. 3 units.

203. Epic: Vergil. The *Aeneid.* 3 units. *Newton*

204. Epic: Lucan and Statius. The development of the Roman epic in the Silver Age. 3 units. *Richardson*

***207. The Prose Epistle.** The letter as a vehicle of communication and as a literary form. 3 units. *Richardson*

***208. The Epistle in Verse.** The verse letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. 3 units.

***209. Fragments of Early Latin.** The remains of Latin poetry of the third and second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. 3 units. *Stanley*

***210. Lyric and Occasional Poetry.** Shorter verse forms; epigram, pastoral, song, and panegyric. 3 units.

***211. Roman Oratory I.** The literary history and criticism of Roman oratory. 3 units. *Richardson*

***212. Roman Oratory II.** A continuation of Latin 211. 3 units.

***221. Mediaeval Latin I.** Latin literature of late antiquity, from Prudentius to the Carolingian Revival. 3 units. *Newton*

***222. Mediaeval Latin II.** Literature in Latin from Charlemagne to the Renaissance. 3 units. *Newton*

***241. Advanced Latin Composition.** Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. 1 unit. *Richardson*

For Graduates

(At least two of these are offered each year.)

301. Latin Seminar I. 3 units.

302. Latin Seminar II. 3 units.

303. Latin Seminar III. 3 units.

304. Latin Seminar IV. 3 units.

305. Latin Seminar V. 3 units. *Newton*

306. Latin Seminar VI. 3 units. *Newton*

312. Proseminar in Latin Palaeography. 3 units. *Newton*

314. Proseminar in Latin Epigraphy. 3 units.

* Not offered in 1973-74.

315. Proseminar in Roman Law. 3 units.

399. Directed Reading and Research. Variable credit. *Newton*

CLASSICAL STUDIES

For Graduates

301. Introduction to Classical Philology. Introduction to the bibliography and principal disciplines of the field. 3 units. *Willis and Graduate Staff*

CLASSICAL STUDIES (ANCIENT HISTORY)

For Seniors and Graduates

***253. Greece to the Orientalizing Period.** 3 units. *Oates*

***254. The Age of the Tyrants and the Persian Wars.** 3 units. *Oates*

***255. The Age of Pericles.** 3 units. *Oates*

***256. The Fourth Century through Alexander.** 3 units. *Oates*

***257. Social and Cultural History of the Hellenistic World from Alexander o Augustus.**

***258. Social and Cultural History of the Graeco-Roman World.**

***260. The History of Rome to 146 B.C.** 3 units. *Staff*

***261. The Roman Revolution, 146-30 B.C.** 3 units. *Oates*

***262. Rome under the Julio-Claudians.** 3 units. *Nixon*

***263. From the Flavian Dynasty to the Severan.** 3 units. *Nixon*

***264. From Septimius Severus to Constantine.** 3 units. *Staff*

***270. The Rise of the Hellenistic Kingdoms.** 3 units. *Oates*

***271. The Hellenistic Kingdoms 250-31 B.C.** 3 units. *Oates*

For Graduates

(At least two of these are offered each year.)

321. Seminar in Ancient History I. 3 units.

322. Seminar in Ancient History II. 3 units.

323. Seminar in Ancient History III. 3 units.

324. Seminar in Ancient History IV. 3 units.

325. Seminar in Ancient History V. 3 units. *Oates*

326. Seminar in Ancient History VI. 3 units. *Oates*

399. Directed Reading and Research. Variable credit. *Nixon*

* Not offered in 1973-74.

CLASSICAL STUDIES (ARCHAEOLOGY)

For Seniors and Graduates

***231. Greek Sculpture.** Techniques and styles of the major schools an personalities in archaic, classical, and Hellenistic free-standing and architectur sculpture. 3 units. *Stanley*

232. Greek Painting. Techniques and style in the various media; emphasi on the problems of chronology, attribution, and iconography of Attic pottery. units. *Stanley*

***235. Roman Architecture.** Significant monuments chosen to exemplify th Roman genius in building in the late Republic and early empire. 3 units *Richardson*

***236. Roman Painting.** Roman pictorial art with concentration on th wall-paintings from Campania. Investigation of techniques, iconography, and th use of pictures in decoration. 3 units. *Richardson*

For Graduates

(One course is offered each year.)

311. Archaeology Seminar I. 3 units. *Stanley*

312. Archaeology Seminar II. 3 units.

Under the terms of a cooperative agreement, graduate students of Duk University may, with the approval of the chairman of their major department, take any graduate course offered by the Department of Classics of the University o North Carolina by the payment of a nominal fee. A list of these courses will be sent upon request.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Salinger in the Department of Germanic Languages and Literature.

201, 202. Romanticism. Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany with some reference to other countries. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. *Salinger*

203, 204. Realism and Symbolism. Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. *Salinger*

* Not offered in 1973-74.

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. 3 units. *Salinger*

213. The Slavs: Literature and Culture, 1918-1939. (See course description under Slavic Languages and Literatures 213.) 3 units. *Krynski*

214. The Slavs: Literature and Culture, 1940-1970. (See course description under Slavic Languages and Literatures 214.) 3 units. *Krynski*

301. The Hero in European Fiction, 1830-1940. Studies in the "loss of self" from Balzac to Robert Musil. Intended primarily for minors in comparative literature. Prerequisite: permission of instructor. 3 units. *Salinger*

Computer Science

Associate Professor Patrick, *Acting Chairman* (405 Computation Center); Professor Gallie, *Director of Graduate Studies* (401 Computation Center); Professors Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond and Starmer; Assistant Professor Ramm; Instructor Austin; Adjunct Associate Professor Williams

The Department of Computer Science (before July 1, 1972, called the Computer Science Program) offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and differential equations and of at east two computer programming languages. The research areas currently active within the program include compiler design, real-time computing, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

For Seniors and Graduates

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory: joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. (Also listed as Electrical Engineering 203.) Fall semesters. 3 units. *Kerr and Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information-extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Prerequisite: Computer Science 203 or permission of instructor. (Also listed as Electrical Engineering 205.) Spring semester. 3 units. *Nolte*

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are al covered. Selected laboratory work is required. Prerequisite: Computer Science 15 or permission of instructor. (Also listed as Electrical Engineering 208.) Sprin semester. 3 units. *Marinos and Owen*

210. Image Processing. Digital image transducers and processing a gorithms, special purpose filters and tracking algorithm as applied to both binar and multi-gray level images; transducer hardware such as flying spot scanners an image dissectors. 3 units. *Starmer and Fortney*

211. Control Programs in Operating Systems. Review of control program such as task scheduling, memory allocation and I O control. The identification c the common features of control programs and the hardware-software tradeoff required for implementation will be studied. Prerequisite: Computer Science 231 3 units. *Austin and Starmer*

212. Advanced Topics in Control Programs. Analysis of selected topic concerned with resource allocation. Simulation of various algorithms will be use to identify constraints in a hypothetical system. Prerequisites: Computer Scienc 231 and 211. 3 units. *Austin and Starmer*

215. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness o programs; readings in simulation of cognitive processes, problem solving, semanti memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or permission of instructor. 3 units. *Austin*

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation an integration, solution of simultaneous linear equations and matrix inversion, rea and complex roots of non-linear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) 3 units. *Patrick*

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors numerical methods for solving ordinary differential equations, partial differentia equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) 3 units. *Patrick and Utku*

223. Numerical Analysis III. Rational approximation methods, spline approximations, optimization techniques, global methods for solving non-linear algebraic equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 223.) 3 units. *Patrick*

231. Introduction to Operating Systems. Characteristics and components of operating systems and methods for their implementation. Program linkage and relocation, job scheduling, resource allocation and interrupt handling, input output control systems, on-line file structures, communications, time sharing and real-time systems. Case studies of both small and large existing systems. Prerequisite: Computer Science 150 or 152. 3 units. *Austin and Starmer*

232. Metaprograms. Programs which process programs: compilers, interpreters, assemblers. Syntax and semantics of programming languages. 3 units. *Gallie*

241, 242. Information Organization and Retrieval. This course deals with ie structure, analysis, organization, storage, searching, and retrieval of informa- on. Studied in particular will be structure of files, dictionary construction and ok-up, search and matching procedures, indexing, file maintenance, and methods r user interaction with the automated system. Practical programming experience such techniques will be included. Prerequisites: Computer Science 51 and 152. units per semester. *Hammond*

244. Econometrics II. A course on the design of computer simulation xperiments for economic systems. Topics include generation of stochastic variates, omputer models of queuing and inventory systems, models of the firm and in- ustry, models of the economy, simulation languages, and experimental design. Also listed as Economics 244.) 3 units. *Naylor*

250. Clustering and Classification. Algorithms and operating characteris- cs of clustering and classification methods. Data models for sequential data ac- uisition, clustering in terms of nearest neighbor, and/or mixtures of distributions missing information principle). Characterization of patient groups versus normal roups and selection of measures to characterize diseases as super-clusters. Appli- ation of Bayes' procedures to classification into clusters and super-clusters. Pre- equisite: permission of instructor. 3 units. *Woodbury*

251. Computer Science for Teachers. An introduction to digital compu- tion which concentrates on computer instruction in the high school and on the mployment of computer processes in instruction and school administration. Pre- equisite: a year of basic mathematical analysis at college level. Summer session. units. *Austin*

265. Advanced Topics in Computer Science. Opportunity for study of dvanced problems in computer science, possibly leading to the development of a ubstantial computer program. 3 units. *Staff*

306. Adaptive Detection and Communication Systems. Sequential detec- on, Wald's sequential probability ratio test, sequential tests of composite hy- otheses, deferred decision theory; adaptive systems, nondecision-directed and ecision-directed measurements, adaptive on-off communications system, trans- itted reference systems, detection systems employing the learning feature, learning ith and without a teacher, pattern recognition. Applications to communication ystems. Prerequisite: Computer Science 205 or permission of instructor. (Also sted as Electrical Engineering 306.) 3 units. *Nolte*

307. Advanced Digital Systems I. A unified treatment of finite-state deter- inistic systems. Models and elementary properties of sequential machines; se- uential machine compatibility; equivalence and state minimization; state assign- ent for sequential machines; state and machine identification experiments; asyn- hronous and speed independent switching circuits; theory of regular expressions. rerequisite: Computer Science 157 or permission of the instructor. (Also listed s Electrical Engineering 307.) 3 units. *Marinos*

308. Advanced Digital Systems II. A continuation of Computer Science 07. Machine decomposition; design of reliable systems from unreliable com- onents; probabilistic and fuzzy automata; recognition devices; automata and their elation to context-free languages. Prerequisite: Computer Science 307 or per- ission of instructor. (Also listed as Electrical Engineering 308.) 3 units. *Marinos*

311. Inverse Biomedical Models. Analytical and computational metho for determining the internal state of a biological system from a set of extern measurements and *a priori* characterization of the system. Difference and integr equation formulations of volume conductor problems, variational methods, pe turbation techniques, eigenvalue problems, and quasilinearization. Particular em phasis is placed on the inherent limitations and difficulties encountered in obtaini numerical solutions from inverse formulations and the value of constraints in r ducing these difficulties. (Also listed as Biomedical Engineering 311.) 3 uni *Pilkington*

321. Topics in Numerical Mathematics. Advanced topics in numeric mathematics to be selected from areas of current research. Prerequisites: Comput Science 221 and 222 or 223. 3 units. *Patrick*

344. Workshop on Computer Models of Social Systems. A course o the methodology of constructing computer simulation models of social syste including political, economic, social, administrative, and educational. Although th emphasis of the course is on a variety of different types of models of social system special consideration is given to the methodology of designing simulation exper ments. (Also listed as Economics 344 and Political Science 344.) 3 units. *Nayl*

350. Advanced Engineering Analysis. Review of general mathemati properties of boundary value, eigenvalue, and initial value problems in continuu and in discrete space; approximate methods for reducing continuum problems int discrete problems, and comparison of such methods; discussion and comparison o solution algorithms for discrete problems; truncation and round-off errors, an error analysis. Prerequisites: Computer Science 221 and 222 or consent of instru tor. (Also listed as Civil Engineering 350.) 3 units. *Utku*

Economics

Professor Davies, *Chairman* (302 Social Science); Associate Professor Weintrau *Director of Graduate Studies* (315 Social Science); Professors Blackburn, Bron fenbrenner, de Vyver, Goodwin, Hanna, Kelley, Kreps, Naylor, Saville, Trem Vernon, and Yohe; Associate Professors Grabowski and Havrilesky; Assista Professors Black, de Marchi, Graham, McElroy, and Salkin

The Department of Economics offers graduate work leading to the A.M. an Ph.D. degrees. A student entering graduate work in economics should have com pleted with satisfactory grades at least 12 semester hours of undergraduate work i economics, including 6 hours of principles of economics. Among the unde graduate courses of distinct advantage to the graduate student in economics ar general accounting, elementary statistics, intermediate economic theory, mone and banking, international trade, and basic courses in philosophy, mathematics, an social sciences other than economics.

Requirements for the Ph.D. in economics include an examination in economi theory at the end of the first year, and, at the end of the second year, examination in three additional fields. The student may select from advanced economic theory history of political economy, economic development, economic history, inter national economics, money and banking, labor economics, public finance, industri organization, econometrics, statistics, Soviet economics, and certain fields outsid the economics department (e.g., demography). Course work for the Ph.D. shoul be completed in four semesters of residence.

or Seniors and Graduates

204. Advanced Money and Banking. 3 units. *Yohe*

231. Economic Development of Europe. Sequence of local. national. and ternational economic structures under situations of changing trade. industry. agri- lture, population. investment, war conditions, public ownership, cartels. colonial- m. and prices. 3 units. *Saville*

***233. State and Urban Finance.** A study of expenditures, taxation. and ancial administration in state and local governments, with emphasis on current oblems. Special attention will be given to research methods and materials, and the financial relations between state and local governments. 3 units. *Davies*

237, 238. Statistical Methods. A study of statistical methods appropriate r dealing with problems in business and the social sciences. In addition to de- loping more thoroughly the subject considered in Business Statistics, the follow- g methods will be considered: multiple, partial, and curvilinear correlation; curve ting; probability; sampling distributions; and statistical inference. Prerequisite: conomics 138 or consent of the instructor. 3 units per semester. *Hanna*

243. Econometrics I. Economic theory, mathematics, statistical inference. d electronic computers applied to analysis of economic phenomena. Objective to give empirical content to economic theory. Matrix algebra used to develop pics in inference, linear regression, and systems of simultaneous equations. Use is ade of the electronic computer. 3 units. *Naylor and McElroy*

244. Econometrics II. A course on the design of computer simulation ex- riments for economic systems. Topics include generation of stochastic variates. mputer models of queuing and inventory systems. models of the firm and indus- y, models of the economy. simulation languages, and experimental design. (Also ted as Computer Science 244.) 3 units. *Naylor*

262. Trade Unionism and Collective Bargaining. An intensive survey of e trade union as an economic institution is followed by a study of the principles d problems of union-management relationship as found in collective bargaining. units. *de Vyver*

265. International Trade and Finance. A study of the fundamental prin- ples of international trade and foreign exchange. Subjects covered will include ternational specialization, balance of payments, foreign investments, tariffs and mmercial policies, exchange control, exchange rates, and international monetary oblems. 3 units. *de Marchi*

268. Competition and Monopoly. 3 units. *Vernon*

287. Public Finance. An analysis of the impact of governmental expendi- res, revenues. and debt on the allocation of resources. the redistribution of in- me, and the stabilization of income. 3 units. *Black and Davies*

293. Soviet Economic History. Economic policy-making in the Soviet nion in an historical setting. 3 units. *Treml*

294. Soviet Economic System. A study of the Soviet economic system with emphasis on theoretical problems of allocation of resources, economic develop-

* Offered on demand.

ment, and optimal micro-decision-making in a non-market economy. 3 uni
Treml

301. Microeconomic Analysis I. Review of contemporary theory relat
to production, the firm, and income distribution in competitive and imperfec
competitive markets. 3 units. *Graham*

302. Microeconomic Analysis II. A continuation of Economics 301, w
emphasis on analyses of consumer behavior, general equilibrium, welfare ec-
nomics, and capital theory. Prerequisite: Economics 301. 3 units. *McElr,*
Salkin, and Weintraub

303. Theory of Economic Decision-Making. The extension of econon
theory to the allocation of resources within firms and governmental units. P
requisite: Economics 301 or its equivalent. 3 units. *Staff*

304, 305. Seminar in Money and Banking. In the first semester, a surv
of theories of the level and structure of interest rates and the relationships amo
the money supply, interest rates, income, and price levels; second semester, rece
issues in monetary theory and monetary policy, particularly theories of cre
rationing, the financial intermediaries controversy, and the monetary policy trar
mission mechanism. 3 units per semester. *Yohe and Havrilesky*

307. Quantitative Analysis I. A systematic analysis of the principal qua
titative methods used in microeconomic theory. Neo-classical theories of producti
and distribution are used as vehicles for presenting the material. Considerable er
phasis is placed on the application of mathematical analysis to economic mode
3 units. *McElroy*

308. Quantitative Analysis II. Linear economic models, particularly Leo
tief models, are used in the exposition. Primary emphasis is placed on the applic
tion of mathematics to economic theory. Prerequisite: Economics 307 or conse
of instructor. 3 units. *Graham*

311, 312. History of Political Economy. A detailed review of the develo
ment of economic theory, the tools of economic analysis, and economics as
science, together with an analysis of the circumstances affecting this developmer
Period covered: pre-Christian times through 1936. 3 units per semester. *Goodw*

313, 314. Seminar in Economic Theory. Prerequisite: Economics 301
its equivalent. 3 units per semester. *Weintraub*

316. Seminar in Economics of Soviet-Type Socialism. Selected topics i
analysis of theoretical and institutional framework of Soviet economic system, suc
as markets versus plan, optimizing techniques in planning, price determinatio
balanced economic development, and ideology and economic policy. 3 unit
Treml

317. Seminar in Demographic, Population, and Resource Problem
3 units. *Staff*

318. Dissertation Seminar. 3 units. *Staff*

319. Seminar in the Theory and the Problems of Economic Growth an
Change. 3 units. *Staff*

320. Macroeconomic Analysis I. Measurement of national income an
other important aggregates; classical macroeconomics; Keynesian and more recer

iews of the determinants of income, employment, and price levels; empirical tudies of consumption, investment, and monetary variables. 3 units. *Blackburn, ronfenbrenner, and Weintraub*

321. Theory of Quantitative Economic Policy. The use of mathematical odels in analyzing the connections between means and ends of economic policy; pics covered include principles and design, centralization and decentralization, abilization and growth policies, welfare optimization, imperfect models, and the se of control system analysis. Prerequisite: Economics 320. 3 units. *Staff*

322. Macroeconomic Analysis II. Further analysis of topics treated in conomics 320. Optimal economic growth; business cycles. Issues in economic olicy. Prerequisite: Economics 320. 3 units. *Weintraub*

323. Income Distribution Theory. Income distributions—functional and ersonal. Concepts and measures of poverty and inequality. Maldistribution issues—thical and economic. Pricing of productive services, primary attention on wages nd employment. Rival aggregative (macro distribution) theories. Prerequisites: termediate micro- and macro-economics and some knowledge of calculus and atistics. *Bronfenbrenner*

329. Federal Finance. An analysis of the trends and hypotheses concern-g the growth in governmental activity, the optimum level and composition of overnmental spending, and the microeconomic and macroeconomic effects of overnmental spending and tax policies. 3 units. *Davies*

330. Seminar in Public Finance. 3 units. *Davies*

331. Seminar in Economic History. 3 units. *Staff*

***340. National Income.** A critical survey of the conceptual framework nd structure of national income and its components, the reliability of national come estimates, and their use in analyzing questions of economic policy. 3 units. *anna*

344. Workshop on Computer Models of Social Systems. A course on e methodology of constructing computer simulation models of social systems in-luding political, economic, social, administrative, and educational. Although the mphasis of the course is on a variety of different types of models of social systems, pecial consideration is given to the methodology of designing simulation experi-ents. (Also listed as Computer Science 344 and Political Science 344.) 3 units. *aylor*

345, 346. Demographic Techniques I and II. (Also listed as Sociology 45, 346.) 3 units each semester. *Myers and Hartford*

350. Seminar in Applied Economics. A course that will use the principles f micro-economics in the analysis of problems and policies. The particular con-xtual materials that will be subjected to analysis will vary from time to time. aterials will be treated in the tradition of positive economics.

355. Seminar in Labor Economics. 3 units. *de Vyver*

358. Seminar in Labor Market and Related Analysis. 3 units. *Staff*

365. Seminar in International Economics. 3 units. *de Marchi*

* Offered on demand.

366. Monetary Aspects of International Trade and Finance. The mc etary, as opposed to the pure, side of international economics. Among the top considered are the balance of payments, the foreign-exchange market capital mov ments, payments equilibrium, the demand for reserves, and international moneta reform. 3 units. *Staff*

***388. Industrial Organization.** The theory, measurement, and history the firm-structure of industry. Emphasis upon the structure of American indust and upon actual production and pricing practices. Criteria for evaluating industr performance. 3 units. *Vernon and Grabowski*

***389. Seminar in Industrial and Governmental Problems.** 3 uni *Vernon*

397, 398. Directed Research.

401. Seminar on the British Commonwealth. 3 units. *Ball, Braiban and Cole*

402. Interdisciplinary Seminar in the History of the Social Science 3 units. *Goodwin, Holley, and Spragens*

Related Courses in Other Departments

Courses in related fields may be selected from anthropology, comput science, forestry, history, mathematics, philosophy, political science, and s ciology, or from an area that complements the candidate's area of research intere in economics.

See Program in Comparative Studies on Southern Asia and the Center f Demographic Studies in the chapter on Special and Cooperative Programs f further information.

Education

Professor Hurlburt, *Chairman* (213I West Duke Building); Associate Professor Johnson, *Director of Graduate Studies* (213C West Duke Building); Professo Cartwright, Gehman, Githens, Hopkins, Petty, Shuman, and Weitz; Associate Pr fessors Adams, Ballantyne, Carbone, Colver, L. Davis, Di Bona, Flowers, Katze meyer, Martin, Pittillo, and Sublett; Adjunct Professor J. Davis

Graduate work in education is offered leading to the A.M., the M.Ed., t M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there a specific requirements and prerequisites, all of which may be found stated in detail this *Bulletin*. Departmental requirements and prerequisites for all of these degre may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selectic may be made which will meet North Carolina requirements for the Advance Principal's Certificate, the Superintendent's Certificate, and the Supervisor Certificate.

(Some courses below are offered only in the summer session; see t *Bulletin of the Summer Session.*)

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* Offered on demand.

These programs are accredited by the National Council for Accreditation of eacher Education for the preparation of elementary and secondary school achers and school service personnel with the doctor's degree as the highest degree pproved.

or Seniors and Graduates

201. Teaching and Supervision of Arithmetic. This course gives special ttention to the number system, the fundamental operations (with whole numbers, actions, and decimals), percentage, and measurements. Consideration given to eaning theory, method of teaching, problem-solving, evaluation, practice and drill. nd selection and gradation of arithmetical contents. Designed for teachers and pervisors in the elementary school. 3 units. *Petty*

202. Comparative and International Education: Industralized Nations. tructure and functioning of educational institutions in selected developed societies. mphasis on relevant social science theory and methods. 3 units. *Di Bona*

204. Educational Organization. Explores theory and research on the processes of exchange between educational organizations and their external environents, and the influence of these processes on organizational structure, goals, and ractices. Schools, colleges, and universities are considered as separate types of ducational organizations, and a comparative approach is emphasized in examining hese as well as other forms of social organizations, e.g., hospitals, businesses, and risons. 3 units. *Martin*

206. Studies in the History of Educational Philosophy. The educational iews of leading thinkers in the history of Western philosophy, including Plato. ugustine, Locke, Rousseau, Kant, Whitehead, and Dewey. 3 units. *Carbone*

207. Social History of Twentieth-Century American Education. The evelopment of twentieth-century American education in the context of social and ntellectual history. 3 units. *Johnson*

211. The Problem Child. Study of problem behavior and adjustment in hildren with emphasis on the causes and treatment of conduct and neurotic isorders of the maladjusted child. Particular attention will be paid to mental ygiene principles in the handling of problem children in school and home. (Also isted as Psychology 211.) 3 units. *I. Gehman*

***213. Elementary-School Organization and Administration.** This course s designed especially for principals, teachers, and other prospective members of the lementary-school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment s given to the problems of internal organization and management of the elementary chool, and its integration with the secondary-school level. 3 units. *Sublett*

215. Secondary Education: Principles. Intensive study of principles, curiculum, and methods in secondary education. Accelerated course meeting six ours a week for half a semester. Must be accompanied by Education 216. 3 units. *artwright, Githens, Johnson, and Shuman*

216. Secondary Education: Internship. Supervised internship in junior r senior high schools. Full-time observation and teaching for half a semester, accompanied by Education 215; or, with permission of the department, full-tir teaching for a semester, accompanied by Education 315. Students carrying Educ tion 216 for credit toward a master's degree will be required to take six hours senior or graduate work in addition to the normal degree requirements. 6 uni *Cartwright, Githens, Hurlburt, Johnson, and Shuman*

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* Offered on demand.

217. The Psychological Principles of Education. An advanced study teaching, learning, and the learner. Selected problems guiding the reading students will be discussed in class. 3 units. *Davis, Gehman, and Weitz*

218. Comparative and International Education: Developing Societie A study of the structure and functioning of educational institutions and process in selected developing nations. Emphasis is placed on the application of releva social science theory and methods of the problems of education. 3 units. *Di Bo*

219. Comparative and International Education: South Asia. Tradition and modern educational developments are studied in the cultural context of tl region. Emphasis is placed on the social, political, and economic consequences schooling in India and Pakistan. 3 units. *Di Bona*

221. Programs in Early Childhood Education. This course is designe to examine the objectives and philosophy underlying the establishment of progran in early childhood education. It will include an overview of existing practices, r search findings and experimental projects dealing with the social, emotional, phy ical, and cognitive development of the young child. 3 units. *Flowers*

222. New Developments in Elementary School Curriculum. Curriculu and materials of the modern elementary school. Special attention is given to ir novations such as the open classroom, team teaching, non-graded programs, an individualized instruction. Recent emphasis on early childhood education an the middle school is assessed. Offered in Summer, 1972. 3 units. *Sublett*

***223. Teaching the Language Arts.** Comparison of current methods an materials in the teaching of handwriting, spelling, and oral and written compositio Analysis and correction of basic difficulties. Increasing opportunities for creati expression. Correlation of language arts with other activities and school subject 3 units. *Adams*

225. The Teaching of History and the Social Sciences. Evaluation c the objectives, content, materials, and methods in the teaching of history an the social sciences. Offered in summer session. 3 units. *Cartwright*

226. Teaching Reading in the Elementary School. A study of the natur of the reading process and of principles, methods, and materials for the develop mental and remedial programs. 3 units. *Adams*

227. The Teaching of Geography. 3 units.

229. Formal and Informal Classroom Diagnosis of Reading Disabilit Cases. Designed to acquaint teachers, supervisors, and administrators with variou standardized tests, other instruments, and informal procedures utilized in diagnosin reading problems of elementary and secondary pupils. 3 units. *Adams*

233. Improvement of Instruction in English. This course will acquaint th student with recent developments in the teaching of English and will introduc

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* Offered on demand.

m to research techniques in the field. Each student will pursue an extensive
dependent study based on his particular interests. 3 units. *Shuman*

234. Secondary-School Organization and Administration. This course is
signed especially for principals, teachers, and other prospective members of the
condary-school staff. The scope of secondary education is considered to encom-
ss junior high school, regular high school, senior high, and junior college.
ecial treatment is given to the problems of internal organization and management.
units. *Pittillo*

236. Teaching Reading in the Secondary Schools. A study of the nature
the reading process and of principles, methods, and materials for the develop-
ent of effective reading attitudes and skills. The course provides diagnostic and
mediation sessions with secondary school students. For secondary school teachers
all subjects who wish to improve the reading and study skills of students at the
condary level. 3 units. *Adams*

237. The Teaching of Literature in Secondary Schools. This course
rveys the literature generally taught in secondary schools. Both adult and transi-
n-type literature are considered. Methods of organizing the program and of
aching literature are explored. 3 units. *Shuman*

238. Content, Supervision, and Administration of Reading Programs.
he nature and functions of the objectives of various reading programs, organiza-
n of such programs, their major attributes, and their evaluation. For supervisors,
achers, and administrators. 3 units. *Adams*

**239. The Teaching of Grammar, Composition, Mechanics, and Usage
Secondary Schools.** This course will be concerned with recent developments
the teaching of grammar, composition, mechanics, and usage. Students will write
d grade compositions. Each student will undertake an appropriate term project.
units. *Shuman*

240. Career Development. Educational, psychological, and sociological
rigins of individual career development; theories of career development and place-
ent of job choice in general human growth and development; use of occupational
d educational information. 3 units. *Ballantyne and Colver*

241. Principles of Guidance and Student Personnel Work. A study of
e history, philosophy, principles, and scope of guidance work in elementary and
condary education and student personnel work in higher education. 3 units.
allantyne and Colver

243. Personality Dynamics. A study of personality structure and dynam-
s with emphasis upon the implications for counseling and instruction. Prerequisite:
x hours of psychology or educational psychology. 3 units. *S. Gehman*

244. Counseling Techniques. A study of individual counseling techniques
cluding diagnosis, interviewing, program planning, and counseling evaluation.
rerequisites: Education 243 and 258 or equivalent, which may be taken con-
rrently. 3 units. *S. Gehman*

245. Theories of Counseling. A study of the major theories of counseling.
units. *Weitz*

246. The Teaching of Mathematics. This course deals with such topi as aims, curriculum, course and lesson planning, and classroom procedure for teac ing secondary-school mathematics. 3 units.

247. Practicum in Guidance and Counseling. Intensive field experien in local settings, designed to provide the student with opportunities to participa in on-going counseling and guidance programs. A minimum of 150 hours of ca work and supervision required. Prerequisites: Education 244 and permission instructor. 3 units per semester. May be repeated. *Ballantyne, Colver, Gehma and Weitz*

248. Practicum in Counseling. Practice in individual counseling, inclu ing test administration, intake interviewing, diagnosis, program planning, repc preparation and evaluation. The student will be expected to devote approximate 150 hours to case work and conferences with his supervisor. Practicum will be he in the University Counseling Center. Prerequisites: Education 244 and permissic of instructor. 3 units per semester. May be repeated. *Weitz*

249. Exceptional Children. A survey of the major categories of exception children, mental retardation, emotional disturbance, brain injured, learning di abilities, physically handicapped, visual and auditory deficits, culturally deprive and gifted. Etiology (biological and environmental factors), diagnosis, and trea ment will be discussed. 3 units. *Erickson*

250, 251. Teaching Emotionally Disturbed Children: Internship. Bas principles and practices in teaching and the organization of instructional material Work with children under the supervision of a certified teacher of emotional disturbed children. Experience in general classroom teaching and small group ar individualized instruction. Participation in staff conferences involving psychiatrist psychologists, social case workers, and professional educators. 3 units per semeste *S. Gehman*

***252. The School in the Legal Structure.** Designed to show the legal rel tionships of the school to federal, state, and local governments. Considerable atte tion to legal rights, responsibilities, and liabilities of the teacher. 3 units. *Mart*

253. Law and Education. The elements and problems of educational o ganization which have come within the purview of constitutional and legislati provisions and appellate court decisions. 3 units. *Martin*

255. Assessment of Abilities. A study of the selection, use, and inte pretation of various types of instruments for predicting and evaluating the outcom of educational experiences including surveys of standardized tests of aptitude an achievement. 3 units. *Colver*

256. Classroom Assessment of Student Achievement. A study of th techniques to be used by classroom teachers in the evaluation of student progres Special emphasis will be directed to teacher-made tests. 3 units. *Colver*

258. Assessment of Personality, Interests, and Attitudes. A study of th rationale, construction, use, and interpretation of standardized instruments designe for the assessment of students' interests, attitudes, and personality. Special emphasi will be directed to the use of these instruments in counseling. Prerequisites: Educa tion 243 and 255, or approval of instructor. 3 units. *Colver and Weitz*

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* Offered on demand.

260. Introduction to Educational Research. Research methodologies: exerimental, historical, survey, philosophic, and case study. Fundamentals of statiscal inference, research design, and computer applications to research problems. units. *Katzenmeyer*

261. Intermediate Educational Research. Intermediate topics in statistical ference. Analysis of covariance and multiple regression. Computer applications research. Research design. Prerequisite: Education 260 or its equivalent. 3 units. *atzenmeyer*

***266. Science in the Elementary School.** Presentation of basic concepts natural and physical science through selected readings, the use of simple experients and demonstrations, construction and use of equipment, and field studies. 3 nits. *Githens*

268. Seminar in Contemporary Educational Criticism. Critical analysis nd discussion of the writings of contemporary critics of education. 3 units. *Carone, Di Bona, and Johnson*

270. The Junior College. A study of the history and role of the junior ollege, and of problems and issues confronting the two-year college. Designed s an introduction to the junior college for students preparing to be teachers or dministrators. 3 units. *Hopkins and Hurlburt*

272. Teaching Communication Skills in Early Childhood Education. n examination of the development of communication skills from birth to age eight ith emphasis on reading readiness and language growth. 3 units. *Adams*

273, 274. Clinical Reading Practicum. Clinical experiences in the diagosis and correction of reading disabilities in elementary and secondary students. rerequisite: permission of instructor. 3 units per semester. *Adams*

276. The Teaching of High-School Science. Discussion, lectures, and ollateral reading, related to such topics as aims, tests, curriculum, classroom and boratory procedure, field trips, and course and lesson planning for secondary-chool science. 3 units. *Githens*

or Graduates

300. Individual Assessment of Intelligence. A study of theories of ndividual intelligence testing with emphasis on the Stanford-Binet and Wechsler. upervised practice in administering, scoring, and interpreting. Permission by intructor only. 3 units. *L. Davis*

302. Seminar in Educational Research. The seminar is primarily for tudents working on dissertations and theses. Students submit research proposals, lan a research project, and make periodic progress reports. Special topics are onsidered as appropriate to the research designs developed. Prerequisite: Educaion 260 or 261. 3 units. *Katzenmeyer*

306. Seminar in Philosophical Analysis of Educational Concepts. elected writings of contemporary philosophers, with special emphasis on such edcational concepts as teaching, learning, knowing, understanding, indoctrination, xplanation, and education. 3 units. *Carbone*

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* Offered on demand.

311. Group Counseling. A study of theories and techniques of counseli for small groups of children, adolescents, teachers, parents, and other adults. Si ulated practice through recorded interviews, transcribed counseling sessions. Pr requisites: Education 244 and Education 245. 3 units. *Gehman*

313. Seminar in Education and Public Policy. The relationship of educ tional administration to the public policy process. (Also listed as Political Scien 313.) 3 units. *Leach and Pittillo*

314. Seminar in Guidance and Counseling. Research, writing, and r porting on selected problems in the field of guidance and counseling. 3 units. *Wei*

315. Seminar in Secondary-School Teaching. Advanced-level conside tion of principles, practices, and problems in secondary-school instruction. D signed particularly to accompany an internship. For students without previous i ternship credit, this course must be accompanied by Education 216. 3 unit *Carbone, Hurlburt, and Johnson*

321. Educational Management. A study of theory and practice of ma agement as applied to education. This course is intended for anyone who has or preparing to have major management responsibilities in the field of educatio 3 units. *Pittillo*

322. Planning and Management of Educational Facilities. A study planning and management of educational facilities and equipment. This course intended for teachers, administrators, and supervisors. 3 units. *Pittillo*

***323. Public School Finance.** A study of educational costs, sources revenue for the support of public education, collection of revenue, basis of distr bution, and accounting for funds spent. 3 units. *Pittillo*

332. Supervision of Instruction. A study of the nature of supervisio underlying principles, and techniques of working with individual teachers and wit groups. 3 units. *Hurlburt*

333. Seminar in Higher Education. An examination of current problem in American higher education, with special emphasis on case studies in organiz tion, administration, and evaluation. For graduate students interested in the ad ministration of higher education or college teaching. 3 units. *Hopkins*

335, 336. Seminar in School Administration. Organization and contr over public education. First semester: attention to governance of education exercised by the different branches and levels of government. Second semeste administrative organization. 3 units per semester. *Hurlburt, Petty, Pittillo, an Sublett*

337. Seminar in Community College Organization. Discussion of th nature, function, and organization of community colleges. Research, writing, an reporting on selected problems. 3 units. *Hurlburt*

338. Seminar in Educational Supervision. Open to students who hav completed Education 332 or its equivalent. 3 units. *Hurlburt*

339. Seminar in Curriculum. Research, writing, and reporting on selecte problems. 3 units. *Cartwright and Sublett*

* Offered on demand.

340. Seminar in Social Studies Curriculum. Research, writing, and eporting on selected problems. 3 units. *Cartwright*

341. Seminar in Elementary School Curriculum. Research, writing, and eporting on selected problems. 3 units. *Sublett*

342. Seminar in Secondary School Curriculum. Research, writing, and eporting on selected problems. 3 units. *Cartwright*

343. History of Higher Education in America. A history of the growth and development of higher education in the United States from 1636 to the present. The early role of religious groups in establishing colleges, the continuing role of private higher education, and the evolutionary development of public higher education, including state and land-grant universities, teachers colleges, state colleges, and community colleges, are stressed. 3 units.

344. Research in Higher Education. Review of theory, practice, and contribution of research as an aid in understanding the functioning of institutions of higher education. Emphasis on empirical studies utilizing the approach and methods of social science. Also specific concern with historical, economic, and philosophical approaches. Will consider new or emerging frontiers of study such as channels of access to higher education, assessment of the learning environment, attitudinal changes in college students, and contributions of the college to societal needs. 3 units.

345. Seminar in Reading Instruction and Research. A study of the major problem areas in contemporary reading teaching, with emphasis on theoretical, historical, and philosophical contributions to the formulation of objectives and methodologies in modern reading instruction. 3 units. *Adams*

346. Seminar in Organization of Pre-Service and In-Service Reading Programs. Student development of various content and instructional strategies for possible implementation in university undergraduate reading and language arts courses and in public school in-service programs. For graduate students interested in teaching reading and language arts courses at the university level or in coordinating and directing in-service education programs in reading. 3 units. *Adams*

347. Student Personnel Services in Higher Education. A study of the basic objectives of student personnel services in post-secondary education and the administrative procedures developed to achieve these objectives. Attention will be directed to many of the specific personnel services. 3 units. *Colver*

348, 349. Seminar in Child Psychopathology. Under the direction of a child psychiatrist, the student will select one elementary school age child for a psychoanalytic study of neurotic conflicts, unconscious motivations, dream work, defense mechanisms, and transference phenomena. Prerequisite: permission of instructor. 3 units per semester. *Fowler*

350, 351. Directed Activities in Education. Selected internship experiences at an advanced level under supervision of appropriate staff. Prerequisite: approval of instructor. 3 units per semester. *Staff*

354. Seminar in Law and Educational Organization. Research, writing, and reporting on selected problems. Prerequisites: Education 204 and 253, or by consent of instructor. 3 units. *Martin*

360. Seminar on Instructional Strategies. This seminar provides a opportunity to examine the strategies espoused for effective instruction by a variet of writers, to examine the relationships among broad purposes of education, th process and product objectives, and the strategies employed to achieve those purposes and objectives. A synthesis among the purposes, objectives, and strategies i sought. 3 units. *Katzenmeyer*

Engineering

George Wilbur Pearsall, Sc.D., *Dean* (136 Engineering)

The School of Engineering offers programs of study and research leading t the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designe to provide a fundamental understanding of the science of engineering, which i based on mathematics and the physical sciences, and to develop experience in th art of engineering, which depends on human imagination and judgment. Each engineering graduate student may participate in seminars appropriate to his field o study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor' degree is required for the M.S. degree: 12 in the major, 6 in related minor work (normally mathematics or natural science), 6 in either the major or minor subjec or in other areas approved by the major department, and 6 for a research-base thesis. A non-thesis option requiring 30 units of course credit is available. Each o the departments imposes additional requirements in the exercise of this option There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering 24 in the major, 12 in related minor work (normally mathematics or natura science), 12 in either the major or minor subject or other areas approved by th major department and the Dean of the School of Engineering, and 12 for a research-based dissertation: in mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. A reading knowledge of one foreign language which is relevant to the field of the dissertation is required (normally French, German, or Russian) in civil engineering, but may be waived under certain circumstances. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman;* Professor Thurstone, *Director of Graduate Studies,* Professors Bennett, Nolte, and Wolbarsht; Associate Professors Barr, Clark, Hammond, Hills, and Wachtel

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage ne optimum combining of engineering and biomedical course work with an inter-isciplinary research topic so that the graduates of this program can contribute at ne most advanced professional level to the interdisciplinary field of biomedical ngineering. The major research areas available include: biomechanics; biomedical naterials; biomedical modeling; data acquisition and processing; and electro-hysiology.

201. Introductory Biomedical Engineering I. Fundamentals of biomedical ngineering, with particular emphasis on cellular, neural, circulatory, and respira-ory phenomena and their representation by analytical models. 4 units. *Wachtel*

202. Introductory Biomedical Engineering II. A continuation of Bio-nedical Engineering 201, with particular emphasis on biological interactions of rtificial materials and prostheses, environmental studies and hyperbaric exposure. rerequisite: Biomedical Engineering 201. 3 units. *Clark*

223. Biomedical Materials and Artificial Organs. The use of artificial rgans to replace or augment natural function in pumping and oxygenation of blood, emoval of nitrogenous wastes and other toxins, and prostheses which have nechanical, chemical, or cosmetic function. Emphasis is placed on molecular rchitecture of materials for use in biological environment and optimization of arameters of materials which determine their utility in varying applications. 3 nits. *Clark*

265. Advanced Topics in Biomedical Engineering. Advanced subjects elated to programs within biomedical engineering, tailored to fit the requirements f a small group. Prerequisite: approval of the chairman and the instructor under vhom work will be done. 1 to 4 units. *Staff*

311. Inverse Biomedical Models. Analytical and computational methods or determining the internal state of a biological system from a set of external neasurements and *a priori* characterization of the system. Differences and integral quation formulations of volume conductor problems, variational methods, per-urbation techniques, eigenvalue problems, and quasilinearization. Particular em-phasis is placed on the inherent limitations and difficulties encountered in obtaining numerical solutions from inverse formulations and the value of constraints in re-ucing these difficulties. (Also listed as Computer Science 311.) 3 units. *Pilking-ton*

333. Biomedical Imaging. A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image genera-tion techniques. Also covered will be the psychometrics of image evaluation dealing with subjective and objective parameters. Emphasis will be placed upon sonography, thermography, X-ray, various forms of nuclear radiography, microscopy, and holog-raphy. 3 units. *Thurstone*

399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: ap-proval of the Director of Graduate Studies. 1 to 3 units per semester. *Graduate Staff*

CIVIL ENGINEERING

Professor Vesić, *Chairman* (121 Engineering); Associate Professor Muga, *Director of Graduate Studies* (051 Engineering Building Addition); Professors Brown and

Utku; Associate Professors Dvorak, Palmer, and J. F. Wilson; Assistant Professo Clough, Dajani, and Vesilind

A student may specialize in one of the following fields of study for either th M.S. or the Ph.D. degree with a major in civil engineering: engineering mechanic structural engineering, soil mechanics and geotechnical engineering, fluid mechanic and ocean engineering, materials science and engineering, environmental enginee ing, and urban systems and transportation engineering. Programs combining stud in some of these areas with business administration, social sciences, and other area of engineering are also available. Each graduate student participates in seminars appropriate to his field of study.

With the approval of the department, a master's degree candidate in civi engineering may choose, in lieu of submitting a thesis, to complete an additiona 6 units of course work plus a special project. If the candidate elects this alternative he is expected to take a comprehensive examination over his graduate course work and also to defend orally his special project.

The candidate for the Ph.D. degree must have a reading knowledge of on foreign language. Normally, this is French, German, Russian, or Spanish, but othe languages may be considered by petition to the department.

Under the Reciprocal Agreement with Neighboring Universities, a studen may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of Nort Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial science may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is basic knowledge of mathematics through linear differential equations, material science, solid mechanics, and fluid mechanics.

201. Advanced Mechanics of Solids. Cartesian tensors. Analysis of states of stress and strain. field equations. Constitutive relations for elastic, viscoelastic. and elastic-plastic solids. Energy principles. Virtual work techniques. limit analysis. The correspondence principle. Application to bars, beams, shafts, beams on elastic foundations, and pressure vessels. Simple torsion and plane problems. Corequisite: Mathematics 285 or equivalent. 3 units. *Dvorak*

202. Experimental Mechanics. Experimental analysis of stress and strain; correlation of theory with experimental data; errors; photoelasticity; strain gages; brittle lacquers similitude principles and design of models; dynamic measurements. 3 units. *J. F. Wilson*

***203. Elastic Stability.** Linear buckling problems of structures in continuum such as bars, rings. beams, curved beams, thin plates. and thin shells. Linear buckling of structures in discrete space, such as trusses, frames, and discrete representations of plates and shells. Differential equation formulations versus extremum formulations in linear buckling problems. Systematic treatment of buckling problems as linear eigenvalue problems in discrete space and in continuum. Numerical methods for eigenvalue extraction. 3 units. *Utku and Wilson*

***204. Plates and Shells.** Formulation of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian thin plates of isotropic and orthotropic material. Solutions in terms of previously tabulated functions. Finite difference methods. Extremum formulation of the plate problem. Finite difference and finite

* Not offered in 1973-74.

element methods as applied to the extremum formulation. Folded plates. Numerical solution methods for the folded plates. Membrane theory of thin shells. 3 units. *Utku*

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: Civil Engineering 201 or equivalent. 3 units. *Dvorak*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies, generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis. (Also listed as Mechanical Engineering 210.) 3 units. *J. F. Wilson and Macduff*

211. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: CE 201. 3 units. *Dvorak*

217. Urban Systems Analysis. Quantitative approaches to the analysis of public services, activities and facilities. Model building. Demand forecasting, cost, performance and impact models. Planning methodologies and system evaluation techniques. Optimization of urban and regional systems. Emphasis on transportation, housing, land-use and public utilities and services. Prerequisites: CE 117, and Engineering 168 or equivalent. 3 units. *Dajani*

***221. Incompressible Fluid Flow.** Steady and unsteady pipe flow, theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluids systems; effect of resistance; tapered conductors. 3 units. *Muga*

222. Open-Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, and flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. 3 units. *Muga*

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivations and solution methods. Selected problems in stability, fingering and capillarity. Applications: saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, well point operation. 3 units. *Muga*

***224. Coastal and Offshore Engineering.** Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, wave spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. 3 units. *Muga*

225. Engineering Hydrology. Study of processes governing the origin, distribution, depletion, and replenishment of water resources and application of this knowledge to the solution of water supply and drainage problems. Topics in-

* Not offered in 1973-74.

clude the hydrologic cycle, hydrometeorology, precipitation, runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. 3 units. *Muga and Vesilind*

230. Matrix Methods for Structural Analysis. A study of the displacement method of structural analysis and the use of matrices in the analysis of rigid frames and trusses; applications to multispan and multistory frames and space trusses. Computer solutions are emphasized. Prerequisite: CE 140. 3 units. *Brown*

231. Structural Engineering Analysis. A study in depth of a number of "classical" topics in structural analysis; elastic arch design, plasticity and limit design; numerical and approximate methods; stiffness and flexibility methods are included. Prerequisite: CE 140. 3 units. *Brown*

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, shear and diagonal tension. Two-way slabs and flat plates design. Prerequisite: CE 133. 3 units. *Brown*

***233. Prestressed Concrete Design.** A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams and columns, partially prestressing and composite design. Prerequisite: CE 133. 3 units. *Brown*

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: CE 134. 3 units. *Palmer*

***235. Foundation Engineering.** An introduction to methods of analysis, design and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; underpinning. Foundation vibrations. 3 units. *Vesić and Clough*

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures, such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells, and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. 3 units. *Vesić and Clough*

243, 244. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. 3 units per semester. *Vesilind*

247. Air Pollution Control. The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor and air pollution law. 3 units. *Vesilind*

248. Solid Waste Management. Collection, treatment, and disposal of solid wastes from wastewater treatment. Filtration and centrifugation theory and application. Pumping of solid-liquid mixtures. Sludge conditioning by chemicals and heat. Sludge combustion, pyrolysis, and drying. Application of systems analysis to collection of municipal refuse. Sanitary landfills and incineration of solid wastes. Reuse and recycling. Prerequisite: CE 124 or consent of instructor. 3 units. *Vesilind*

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* Not offered in 1973-74.

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods and digital computers as problem solving techniques. 3 units. *J. F. Wilson*

***304. Advanced Plates and Shells.** Differential equation formulation of thin shell problems in general curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution and plates. Solution methods in terms of previously tabulated functions; asymptotic integration method; Geckeler's approximation. Finite difference methods as applied to the differential equation formulation. Extremum formulation of the thin shell problems. Numerical solution methods starting from the extremum formulation of the problem. Treatment of nonlinear behavior of shells. Prerequisite: CE 204. 3 units. *Utku*

***305. Advanced Elasticity.** Complex variable methods in theoretical elasticity; stress, displacement, and mixed boundary value problems in plane strain and longitudinal shear (antiplane strain); axial symmetry. Dynamic boundary value problems; moving loads, punches, and cracks. Prerequisite: Civil Engineering 205 and Mathematics 286. 3 units. *Dvorak*

***306. Plasticity.** Time-dependent and time-independent inelastic material behavior. Stability, yield conditions and yield surfaces, normality and convexity in stress space. Plastic flow, work hardening, unloading, shakedown. Incremental and deformation theories of plasticity. Uniqueness of solutions. Elastic-plastic problems for cylindrical tubes and spherical shells, torsion of prismatic bars. Rigid-perfectly plastic solids. Lower and upper bounds, theorems of limit analysis. Theory of slip-line fields. Application to problems in plane strain and in three-dimensions. Prerequisite: Civil Engineering 205. 3 units. *Dvorak*

307. Viscoelasticity. Models and definitions of linear viscoelastic solids, viscoelastic functions and their interrelations. Correspondence principle. Three-dimensional viscoelasticity, solution of boundary value problems. Waves, vibration and pulse propagation in viscoelastic rods and beams. Beams on viscoelastic foundations under moving loads. Experimental methods in viscoelasticity. Prerequisite: CE 205 or equivalent. 3 units. *Dvorak*

309. Advanced Dynamics. Vibration and stability (small and global) of discrete and continuous structural systems; Liapounov's theorems; parametric and random excitation. Prerequisite: CE or ME 210 or permission of instructor. (Also listed as Mechanical Engineering 309.) 3 units. *J. F. Wilson*

***321. Mechanics of Ideal Fluids.** Basic equations of ideal fluid flow; potential and stream functions; vortex dynamics; body forces due to flow of fluids; methods of singularities in two-dimensional flows; analytical determination of potential functions; conformal transformations; free-streamline flows. Prerequisite: Mathematics 286 or equivalent. 3 units. *Muga*

331. Advanced Structural Analysis I. Basic theory of elasticity. Energy theorems. Basic procedures of the displacement method; connectivity matrix, repre-

* Not offered in 1973-74.

sentation of the essential boundary conditions. properties of the elemental matrices general assembly algorithms. Stiffness matrices and load vectors for line elements 2- and 3-dimensional elasticity elements, plate and shell elements, solids of revolution elements, and shells of revolution elements. Various specializations of the general upper-lower procedure for symmetric positive definite systems. Computation of stresses in the displacement method. 3 units. *Utku*

332. Advanced Structural Analysis II. Basic procedures of the force method, equilibrium equations as constraint equations, structure cutter in choosing a basis in the constraint equations, properties of the elemental matrices, some examples of the element flexibility matrices for various elements. Nonlinear equilibrium problems of structures, incremental load technique. Geometric stiffness matrices for finite elements. Treatment of the general linear buckling problems of the structures. Mass matrices for finite elements. Free vibration problems of initially stressed and unstressed structures. Methods of eigenvalue extraction in positive definite and symmetric systems. Response of structures to deterministic and random dynamic exitations. 3 units. *Utku*

335. Mechanical Behavior of Soils. Origin of soils, soil minerals, and processes of soil formation; physical chemistry of multiphase systems and soil structure Permeability and flow of water through soils: capillary and osmotic phenomena soil compressibility; theory of consolidation; shear strength and failure criteria Stress-strain relationships, volume changes and pore pressures during shear. strength properties. Advanced laboratory soil testing techniques. 4 units. *Vesić and Clough*

336. Advanced Soil Mechanics. Theories of plastic and elastic equilibrium of soil masses and their application to analysis of problems such as pressure on retaining walls, anchored bulkheads, cofferdams, silos. shafts. tunnels; stability of slopes; stresses and settlement in soil masses and pavement, piles and pile groups subjected to lateral loads. Prerequisite: CE 335. 4 units. *Vesić*

337. Elements of Soil Dynamics. Behavior of soils and foundations under transient and impact loads. Mechanics of pile driving. Foundation vibrations. Effects of explosions on soils: wave propagation, cratering. Earthquake effects on foundations, earth dams, and slopes. Compaction of loose soils by explosives or by vibration. Behavior of layered systems under dynamic loads. Prerequisite: CE 335 or consent of instructor. 3 units. *Vesić and Clough*

338. Rock Mechanics. Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock testing techniques. 4 units. *Clough*

350. Advanced Engineering Analysis. Review of general mathematical properties of boundary value, eigenvalue and initial value problem in continuum and in discrete space; approximate methods for reducing continuum problems into discrete problems, and comparison of such methods; discussion and comparison of solution algorithms for discrete problems; truncation and round-off errors. and error analysis. Prerequisite: Computer Science 221 and 222 or consent of instructor. (Also listed as Computer Science 350.) 3 units. *Utku*

365. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. *Graduate Staff*

399. Special Readings in Civil Engineering. Special individual readings n a specific area of study in Civil Engineering. Prerequisite: approval of the Direc-or of Graduate Studies. 1 to 3 units. *Graduate Staff*

Electrical Engineering

Professor H. Owen, *Chairman* (130 Engineering); Associate Professor Hacker, *Director of Graduate Studies* (111 Engineering); Professors Artley, Kerr, Marinos, Nolte, Pilkington, Thurstone, and Wilson; Associate Professors Joines and Wang: Assistant Professor George

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid-state materials and devices; ferromagnetics; super-conducting circuits; instrumentation; electronics; microwaves; automatic control; energy conversion; digital systems; stochastic systems; and information processing.

A minimum prerequisite to the graduate courses in electrical engineering is a basic knowledge of differential equations, electric and magnetic field theory, and the theory of networks. A previous course in modern physics is recommended. There is no foreign language requirement. A qualifying examination is required for the Ph.D. program.

A program in stochastic system analysis is offered in cooperation with the Department of Mathematics at Duke and the Departments of Statistics and Mathematics at the University of North Carolina at Chapel Hill. For further details concerning this program, refer to the description under Special and Cooperative Programs.

For Seniors and Graduates

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory: joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. (Also listed as Computer Science 203.) Fall semester. 3 units. *Kerr and Nolte*

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Prerequisite: EE 203. Spring semesters 1974, 1976. 3 units. *Marinos and Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information-extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Application to problems in communication theory. Prerequisite: EE 203 or permission of instructor. (Also listed as Computer Science 205.) Spring semester. 3 units. *Nolte*

208. Digital Computer Design. Hardware implementation of combinationa and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detail design and simulation of a general-purpose computer system. Computer architectures based on macromodules hardware compiler implementations, and parallel processing concepts are also covered. Selected laboratory work is required. Prerequisite: EE 157 or permission of instructor. Spring semester. (Also listed as Computer Science 208.) 3 units. *Marinos and Owen*

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrödinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: permission of instructor. Fall semester. 3 units. *George and Hacker*

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric, magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; and superconductors. Prerequisite: EE 211. Spring semester. 3 units. *Artley and Hacker*

***213. Principles of Magnetism.** A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: permission of instructor. 3 units. *Artley and Hacker*

***215. Semiconductor Physics.** A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: EE 211 or permission of instructor. 3 units. *Hacker*

217. Masers. Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: permission of instructor. Two class sessions and laboratory. Spring 1975, 1977. 3 units. *George*

222. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations—analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and force oscillating systems. (Also listed as ME 232.) Fall semester. 3 units. *Wilson*

225. Semiconductor Electric Circuits. Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Prerequisite: permission of instructor. Spring semester. 3 units. *Joines*

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* Offered on demand.

227. Network Synthesis. Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Prerequisite: permission of instructor. Fall semester 1973. 3 units. *George*

242. Modern Control and Dynamic Systems. See course description for ME 230. (Also listed as ME 230.) 3 units. *Wright*

243. Advanced Linear Systems Theory. Linear spaces and linear operators, mathematical description of systems, controllability and observability of Jordan form dynamical equations; multivariable and composite systems; state feedback and state estimators, equivalent systems and minimal realizations. Observer theory. Design of poleplacement compensators. Study of technical papers from various journals. Prerequisite: EE 242 or equivalent. Fall semester. 3 units. *Wang*

***259. Advanced Electric Energy Conversion.** Equations of motion of electromechanical systems; fields and lumped parameters, state function concepts; mathematical techniques for analyzing electromechanical devices and systems; transducers; unified treatment employing matrix, tensor, and block-diagram concepts to obtain response under static and dynamic conditions; the generalized rotating machine. Prerequisite: permission of instructor. 3 units. *Trickey*

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisite: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. *Staff*

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, force and energy relations. Prerequisite: permission of instructor. Fall semester. 3 units. *Joines*

272. Applications of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Prerequisite: EE 271. Spring semesters 1974, 1976. 3 units. *Joines*

297-298. Thesis Research. 6 units.

For Graduates

304. Estimation, Filtering, and Random Systems. Statistical estimation and filtering techniques applied to signal analysis and system identification. Wiener and Kalman filter theory in the estimation of system state variables and system parameters. Statistical treatment of linear random operators and random differential equations. Applications to communications and control, with selected computer exercises. Prerequisite: EE 203. Fall semester. 3 units. *Kerr*

305. Advanced Applications of Statistical Decision Theory. Optimum modulators and demodulators, comparison of various systems, Gaussian signals in Gaussian noise; sonar-radar problem, representation of narrow band processes,

* Offered on demand.

slowly fluctuating targets, optimum receiver for estimating range and Doppler properties of autocorrelation functions and ambiguity functions, pseudo-random signals, resolution, frequency spreading, reverberation. active sonar, optimum space time system, and passive sonar. Prerequisite: EE 205. Fall semesters 1974, 1976 3 units. *Nolte*

306. Adaptive Detection and Communication Systems. Sequential detection, Wald's sequential probability ratio test, sequential tests of composite hypotheses, deferred decision theory; adaptive systems, nondecision directed and decision-directed measurements, adaptive on-off communications system, transmitted reference systems, detection systems employing the learning feature, learning with and without a teacher, pattern recognition. Applications to communication systems. Prerequisite: EE 205. (Also listed as Computer Science 306.) Fall semesters 1975, 1977. 3 units. *Nolte*

307. Advanced Digital Systems I. A unified treatment of finite-state deterministic systems. Models and elementary properties of sequential machines; sequential machine compatibility; equivalence and state minimization; state assignment for sequential machines; state and machine identification experiments; asynchronous and speed independent switching circuits; theory of regular expressions. Prerequisites: EE 157 or permission of instructor. Fall semesters 1975, 1977. (Also listed as Computer Science 307.) 3 units. *Marinos*

308. Advanced Digital Systems II. A continuation of EE 307. Machine decomposition; design of reliable systems from unreliable components; probabilistic and fuzzy automata; recognition devices; automata and their relation to context-free languages. Prerequisite: EE 307 or permission of instructor. (Also listed as Computer Science 308.) Spring semesters 1974, 1976. 3 units. *Marinos*

***311. Quantum Theory of Materials.** Concepts of the quantum theory of solids as applied to engineering materials. Topics selected will vary with the interests of the class, but the importance of quantized fields in crystals (phonons, magnons, plasnons, excitons, and polarons) and the interaction of these fields will be stressed. Prerequisites: EE 211 and Physics 316. 3 units. *Staff*

***313. Magnetic Processes in Materials.** Selected topics in magnetism. Cryomagnetics, spin wave resonance, interaction of superconductor and ferromagnetic materials, nonlinear spin wave theory, effects of finite dimensions and interfaces on basic properties of ferromagnets. Microwave applications. Prerequisite: EE 213 or permission of instructor. 3 units. *Hacker*

321. Nonlinear Magnetic and Semiconductor Circuits. Mathematical description of nonlinear magnetic and semiconductor characteristics; transient and steady-state analysis and synthesis of nonlinear systems with application of such topics as magnetic amplifiers, frequency converters, oscillators, computer logic, switching devices, and inverters. Prerequisite: permission of instructor. Spring semesters 1975, 1977. 3 units. *Wilson*

324. Nonlinear Oscillations in Physical Systems. Analysis of phenomena encountered in free and forced oscillating systems: stability criteria, topological methods, degenerate systems and discontinuous theories, relaxation oscillations, asymptotic approaches. Emphasis on interdependence of physical and mathematical

* Offered on demand.

reasoning in analyzing nonlinear electrical and mechanical systems. Illustrative examples selected to meet interests of class. Prerequisite: EE 222. Spring semesters 1974, 1976. 3 units. *Wilson*

342. Optimal Control Theory. The maximum principle of Pontryagin and the Hamilton-Jacobi equation. Properties and design of optimal systems: minimum-time, -fuel, and -energy problems. Optimal linear systems with quadratic criteria. Classical variational theory: The Euler-Lagrange equation, two-point boundary value problems. The problem of Mayer and Bolza, Riccati matrix differential equation. Dynamic programming of Bellman: multistage decision process, principle of optimality and properties of the optimal value function. Selected laboratory work. Prerequisite: EE 243. Spring semesters 1975, 1977. 3 units. *Wang*

345. Stochastic Control Systems. Wiener process, Poisson's processes, Markov chains, stochastic finite-stage machines and semi-Markovian processes. Stochastic control systems, stability of stochastic systems. Mean square error analysis, Wiener filters, statistical equivalent linearization and identification of control systems by statistical techniques. Fixed-memory, expanding-memory, fading-memory filters and Kalman's filters. Stochastic dynamic programming and optimization of stochastic control systems. Prerequisites: EE 203 and 243. Spring semesters 1974, 1976. 3 units. *Wang*

361, 362. Electrical Engineering Seminar-Journal. A weekly seminar in which graduate students and the electrical engineering faculty meet to discuss research and professional activities. Although this carries no graduate credit, it is expected that each graduate student will participate in the seminar for at least two semesters while in residence at Duke University. *Artley*

371. Advanced Electromagnetic Theory. An advanced treatment of topics in electromagnetic theory selected from the interests of the instructor and students. Representative topics are propagation in anisotropic media, plasma waves, antennas, and boundary value problems. Prerequisite: EE 272. Fall semesters 1974, 1976. 3 units. *Artley*

373. Selected Topics in Field Theory. An advanced treatment of topics in generalized field theory selected from the interests of the instructor and the students. Representative topics are generalized fields, electromagnetic interactions, quantum electrodynamics, inhomogenous media, and diffusion phenomena. Prerequisite: EE 272. Spring semesters 1975, 1977. 3 units. *Artley*

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff*

Mechanical Engineering

Professor Chaddock, *Chairman* (142A Engineering); Assistant Professor Buzzard, *Director of Graduate Studies* (143 Engineering); Professors Garg, Harman, Kenyon, Linderoth, Macduff, and Pearsall; Associate Professors Clark, Cocks, Elsevier, and Shepard; Assistant Professors Munson and Wright

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in mechanical engineering. Departmental programs of advanced study and research include control systems, dynamics and vibrations, fluid mechanics, heat and mass transport, mechanical design, metallurgy, corrosion, fracture, polymer science, and thermodynamics. The mechanical engineering faculty cooperate with faculty members from a number of other departments and schools to establis interdisciplinary research projects and programs of study in areas which includ applied mechanics, biomechanics, biomedical materials, energy conversion, environmental quality and control, interaction of fields and materials, ocean engineering systems engineering, engineering and public policy, and transportation systems

The program includes the opportunity for experimental work as well a theoretical study. An increasing emphasis is placed upon developing the researc ability of the student and relating the program to the evolving needs of moder engineering practice.

202. Theoretical Thermodynamics. Classical thermodynamics and thermodynamics of continuum properties for real substances, equilibrium, introduction t statistical thermodynamics. 3 units. *Harman*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies, generalized coordinates and Lagrange' equations; introduction to stability and random dynamic analysis. (Also listed a CE 210.) 3 units. *Macduff and Wilson*

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention to recent developments in the processing and use of modern plastics and fibers. 3 units. *Clark and Pearsall*

214. Environmental Factors in Materials Science. Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. 3 units. *Cocks and Shepard*

215. Failure Analysis and Prevention. A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or permission of instructor. 3 units. *Cocks and Shepard*

221. Compressible Fluid Flow. The concepts and analysis for flow of gases in subsonic to hypersonic regime. Two-dimensional flow; oblique shocks; experimental techniques. 3 units. *Harman and Munson*

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. 3 units. *Buzzard and Chaddock*

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. Prerequisite: ME 126. 3 units. *Buzzard and Munson*

230. Modern Control and Dynamic Systems. The state-space point of view is used as a vehicle to integrate the classic control and modern systems techniques. Topics include vector differential equations, modal matrix transformation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Listed also as EE 242.) 3 units. *Wright*

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies of mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. 3 units. *Macduff and Wright*

232. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variations of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. (Listed also as EE 222.) Fall semester. 3 units. *Wilson*

233. Fluid Control Systems. A design-oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; DC and AC hydraulic and pneumatic amplifiers. 3 units. *Macduff and Munson*

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. 3 units. *Macduff*

251. Refrigeration and Cryogenics. Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Simultaneous heat and mass transfer in refrigeration. Production of low and very low temperatures. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. 3 units. *Chaddock*

255. Energy Conversion. Principles, thermodynamics, and classification of energy conversion devices. Introduction to semi-conductors, thermoelectric generators, photovoltaic generators, thermionic generators, magnetohydrodynamic generators, fuel cells, and other energy conversion devices. 3 units. *Harman*

265. Advanced Topics in Mechanical Engineering. Study of advanced subjects in mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and the instructor under whom work will be done. 1 to 3 units. *Graduate Staff*

270. Theory of Lubrication and Bearing Design. A study and analysis of the theory of hydrodynamic and hydrostatic lubrication. An examination of dynamics of bearing loading, bearing design and materials. Properties of lubricants Students will work on real bearing problems taken from industry, constructio equipment, transportation and wherever relative motion is required between adjacent surfaces. 3 units. *Linderoth*

280. Nuclear Reactor Power Cycles. Basic reactor principles and types Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow and materials problems unique to reactor design. 3 units. *Kenyon*

300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. *Graduate Staff*

302. Advanced Thermodynamics. Classical thermodynamics of inherently irreversible processes. Statistical thermodynamic analysis of properties of real substances and processes. Principles of general thermodynamics. 3 units. *Harman*

309. Advanced Dynamics. Vibration and stability (small and global) of discrete and continuous structural systems; Liapounov's theorems; parametric and random excitation. Prerequisite: ME 210 or permission of instructor. (Also listed as CE 309.) 3 units. *Wilson*

311. Behavior of Crystalline Solids. An advanced treatment of the dependence of structure on atomic bonding, and of properties on structure in crystalline solids. Crystal structures; phase diagrams and solid-state thermodynamics; physical properties; mechanical properties; kinetics of thermal treatments. 3 units. *Cocks, Pearsall, and Shepard*

322. Mechanics of Viscous Fluids. Equations of motion for a viscous fluid; general properties and selected solutions of the Navier-Stokes equations; laminar boundary layer equations with selected solutions and approximate techniques; origin of turbulence. 3 units. *Buzzard*

323. Convective Heat Transfer. Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, condensation, and simultaneous heat and mass transfer. Prerequisites: Mathematics 285, ME 222 or equivalent. 3 units. *Chaddock*

324. Conduction and Radiation Heat Transfer. Conduction heat transfer in steady and transient state. Radiation exchange involving absorbing and emitting media including gases and flames, combined conduction and radiation and combined convection and radiation. Exact and approximate methods of solution including separation of variables, transform calculus, numerical procedures, and integral and variational methods. Prerequisites: Mathematics 285, ME 222 or equivalent. 3 units. *Buzzard and Chaddock*

326. Hydrodynamic Stability. An introduction to the field of the stability of fluid motion; theoretical and experimental results. Criteria governing transition from laminar to turbulent or secondary laminar flow. Consideration of small (linear theory) or finite (energy theory) disturbances; thermal instability of fluid layers; two dimensional parallel flow; boundary layer and jet instabilities. 3 units. *Munson*

331. Nonlinear Control Systems. Design of controls for inherently nonlinear systems and the solution of control problems by introduction of nonlinear elements. Stability and optimization. Describing functions and phase-plane techniques for design of nonlinear systems. Parameter analysis. Computer solutions for signal stabilization. Prerequisite: ME 232 or permission of instructor. *Garg and Wright*

333. Seminar in Control Systems. Discussion of modern developments from the areas of system dynamics, linear, nonlinear, and optimal control; development and use of computational techniques for system analysis and synthesis; emphasis on recently published writing in the controls field; topics to be selected to match the interests of the student group; term paper required. Prerequisites: knowledge of basic linear control theory (e.g., ME 230, EE 243 or equivalent) and computer programming (e.g., ME 31, Engineering 31, CPS 51 or equivalent) or permission of instructor. 3 units. *Garg*

335. Analytic Methods in Vibrations. Time and frequency domain analysis, generalized coordinates and Lagrange's equations, natural modes of continuous systems, approximate methods, damped systems, introduction to random vibrations. Prerequisite: ME 235 or permission of instructor. 3 units. *Wright*

372. Finite Element Techniques in Design. Finite element methods applied to design problems in stress analysis; temperature distribution; and flow problems. Derivation of state vectors and transfer matrices for rectangular and triangular elements; accuracy and computation methods; comparison with difference equation methods and available analytical results. 3 units. *Macduff*

399. Special Readings in Mechanical Engineering. Individual readings in advanced study and research areas of mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Faculty*

English

Professor Ferguson, *Chairman* (323 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professors Anderson, Budd, Duffey, Lievsay, Randall, Reiss, Ryals, Sanders, Smith, Turner, and Williams; Associate Professors Clubbe, Gerber, Jackson, Jones, Krueger, Mellown, Monsman, and Strandberg; Assistant Professors Butters and DeNeef

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D., two languages determined by the student's committee.

For Seniors and Graduates

207, 208. History of the English Language. First semester, Old English grammar and readings; second semester, the development of Middle English and Modern English. 3 units per semester. *Nygard and Reiss*

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. 3 units. *Butters, Nygard, and Reiss*

210. Old English Literary Tradition. 3 units. *Nygard and Reiss*

212. Middle English Literary Tradition. 3 units. *Nygard and Reiss*

215, 216. Chaucer. Reading and interpretation of *The Canterbury Tales* in the first semester, of *Troilus and Criseyde* and the minor poems in the second. 3 units per semester. *Nygard and Reiss*

221. English Prose of the Sixteenth Century. Readings in the major forms and authors. 3 units. *Lievsay*

222. English Non-Dramatic Poetry of the Sixteenth Century. Extensive select readings from representative types and authors, excluding Spenser. 3 units. *DeNeef, Krueger, and Lievsay*

223. Spenser. A study of his works. 3 units. *Lievsay*

224. Shakespeare. The plays. 3 units. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. The first semester includes Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. The second semester, which emphasizes Jonson, is devoted also to Webster, Beaumont, Fletcher, Massinger. Middleton, Ford, and Shirley. 3 units per semester. *Randall*

229, 230. English Literature of the Seventeenth Century. Major works in prose and poetry from 1600 to the death of Dryden. 3 units per semester. *Jackson (230), Lievsay, Randall, and Williams (229)*

232. Milton. Milton's poetry and prose, with emphasis on the major poems. 3 units. *Lievsay*

234. English Drama, 1642-1800. The heroic play and the comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. 3 units. *Jackson*

235, 236. The Eighteenth Century. Swift, Pope, Defoe, Addison, Steele, and others are studied in the first semester; in the second, Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. 3 units per semester. *Ferguson and Jackson*

241, 242. English Literature of the Early Nineteenth Century. The Romantic poets and prose writers. First semester, 1790-1810, with emphasis on Blake, Wordsworth, and Coleridge; second semester, 1810-1830, with emphasis on Byron, Shelley, and Keats. 3 units per semester. *Clubbe and Sanders*

245, 246. English Literature of the Later Nineteenth Century. The first semester is devoted chiefly to Carlyle, Dickens, Thackeray, Tennyson, and Browning; the second semester to Arnold, Ruskin, Pater, George Eliot, Meredith, the pre-Raphaelites, and Swinburne. 3 units per semester. *Clubbe, Monsman, Ryals, and Sanders*

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. The first semester will include Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence; the second semester, Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. 3 units per semester. *Mellown and Smith*

263, 264. American Literature, 1800-1865. The writers emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. 3 units per semester. *Anderson, Budd, Jones, and Turner*

267, 268. American Literature, 1865-1910. Selected works of representative authors. The first semester will include Whitman, Lanier, Mark Twain, James, Howells, Emily Dickinson, and the Local Colorists; the second semester, Crane, Norris, Moody, London, Dreiser, Edith Wharton, O'Neill, Robinson, and Frost. 3 units per semester. *Budd*

270, 271. Southern Literature. The principal authors and the chief literary development from the beginning to the present. Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Mark Twain, Ellen Glasgow, and Faulkner. Attention is given to the historical and cultural background and to literary relations extending outside the region. 3 units per semester. *Turner*

275, 276. American Literature Since 1910. First semester, selected fiction from Gertrude Stein to the present. Second semester, poetry from the Imagist movement to the present. 3 units per semester. *Duffey and Strandberg*

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. 3 units. *Nygard*

285. Literary Criticism. A study of the Greek and Roman critics, in chronological order but with emphasis on their permanent value rather than on the mere history; also of the Continental and English critics to about 1700. 3 units. *Lievsay*

287. Recent Critical Thought. A survey of ideas relevant to the development of modern literature and its cultural relations. 3 units. *Duffey*

289. Literary Biography. Reading and discussion of works by Plutarch, Roper, Walton, Aubrey, Mason, Johnson, Boswell, Lockhart, Carlyle, Froude, Gosse, and Strachey: the development of the literary form, its various methods, and various theories of its nature and purpose. 3 units. *Sanders*

For Graduates

310. Beowulf. Reading and interpretation of the text. 3 units. *Nygard*

312. Studies in Middle English Literature. The literature of England from 1100 to 1500 (excluding Chaucer); a study of medieval genres with a close reading of selected major works. 3 units. *Nygard and Reiss*

315. Studies in Chaucer. 3 units. *Nygard and Reiss*

318. Medieval Romances. Origins, types, forms, themes; special attention to Arthurian materials. 3 units. *Reiss*

320. Studies in Renaissance English Prose. Close readings in various forms and authors as they reflect the culture and thought of the Renaissance. 3 units. *Lievsay*

324. Studies in Shakespeare. Intensive study of carefully limited topics, together with critical analysis and interpretation of selected texts. 3 units. *Williams*

329. Studies in the Metaphysical Poets. A careful study of Donne, Herbert, and Vaughan against the seventeenth-century background, with some attention to their influence on other writers in the period and their impact on twentieth-century poetry. 3 units. *Lievsay and Williams*

330. Studies in Dryden and His Age. The early poems, the important odes, the religious and political poems, selected critical and controversial prose and the heroic play and tragedy. 3 units. *Jackson*

337. Studies in Swift. Intensive study of the major prose; selected readings in the verse, political writings, and miscellaneous prose. 3 units. *Ferguson*

338. Samuel Johnson's Literary Criticism and Related Topics. 3 units. *Ferguson*

339. The Eighteenth-Century Novel. Richardson, Fielding, Smollett, and Sterne are emphasized. Attention is given to earlier prose fiction and to other contributing literary patterns. 3 units. *Ferguson*

341. Studies in English Romanticism. 3 units. *Clubbe and Sanders*

343. Studies in the Critical and Philosophical Ideas of Coleridge and Carlyle. 3 units. *Sanders*

347. Studies in Victorian Poetry. 3 units. *Ryals*

348. Studies in Victorian Fiction. 3 units. *Ryals*

349. Studies in Nineteenth-Century Nonfictional Prose. 3 units. *Sanders*

353. Studies in British Poetry of the Twentieth Century. Detailed examination of major poetic texts, with background readings in prose. 3 units. *Smith*

361. Studies in a Major American Author of the Early Nineteenth Century. 3 units. *Anderson, Jones, and Turner*

362. Studies in a Major American Author of the Later Nineteenth Century. 3 units. *Budd*

364. Hawthorne and Melville. Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 units. *Jones and Turner*

368. Studies in American Realistic Fiction. Intensive study of a post-Civil War novelist such as Howells, with lesser attention to a representative precursor such as De Forest, and a twentieth-century writer such as Dreiser. 3 units. *Budd*

369. Studies in American Humor. The native tradition in the Down-East humorists and the humorists of the Old Southwest, in Mark Twain and his contemporaries, and afterward. 3 units. *Turner*

376. Studies in Twentieth-Century American Literature. Selected problems posed by the poetry, prose, fiction, or drama of this century. 3 units. *Duffey*

380. The Traditional Ballad and Folksong. Studies in English, Scottish, and American popular poetry, with attention to the textual and musical traditions. (No technical knowledge of music is required.) 3 units. *Nygard*

383. Textural Criticism. The principles of analytical bibliography and ieir application to problems and procedures in the study of Elizabethan printed ooks. 3 units. *Williams*

100. English for Foreign Students. A non-credit semester course in Enish for foreign students. Restricted to registered undergraduate and graduate reign students and, to capacity, to employees and wives of foreign students.

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rofessor Ralston, *Dean* (213 Biological Sciences Building); Professor Anderson, *irector of Graduate Studies* (04 Biological Sciences Building); Professors Barnes, arrar, Hellmers, Knoerr, Kramer, and Stambaugh; Associate Professor Yandle; djunct Associate Professors Clark, Hodges, Metz, and Vukovich; Assistant Prossors Chapman, Convery, and Wuenscher

Major and minor work is offered in the natural and social aspects of forestry nd related areas of natural resources leading to the Master of Arts, Master of cience, and Doctor of Philosophy degrees. Work for these degrees may be ursued in the biological science areas of dendrology, wood anatomy, forest ecology, ee physiology, biochemistry, forest entomology, and forest pathology; in the nvironmental science areas of forest soils, meteorology, and hydrology; in resource conomics; and in forest mensuration, biometry, and operations research. College raduates who have had specialized training in professional forestry or the related asic areas of the natural or social sciences will be considered for admission. Stuents will be restricted to the particular fields of specialization for which their cademic background qualifies them. For information on professional training in restry, the *Bulletin of the School of Forestry* should be consulted.

The specific degrees available in forestry and related natural resources rough the Graduate School are: the Master of Arts (with or without a thesis), aster of Science (with a thesis), and the Doctor of Philosophy degrees. Students ajoring in forestry must demonstrate satisfactory knowledge of one foreign nguage as part of the requirements for both the Master of Arts and Doctor of hilosophy degrees. More information on degree and language requirements can be und in the program information section of this *Bulletin*.

IOLOGICAL SCIENCE

endrology and Wood Anatomy

241. Dendrology. Nomenclature, classification, identification, and silviculural characteristics of woody plants. Special attention is given to the tree species ndigenous to southeastern United States and other important forest regions of emperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. *arrar and White*

290. Wood Anatomy. Study of the physical features and the gross and minute structural characteristics of wood leading to the identification of the commercial woods of the United States, and the important tropical woods used in American wood-working industries. Elementary microtechnique. Prerequisites: one year of biology, Forestry 241, or equivalent. 3 units. *Harrar*

292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 290 or equivalent. 3 uni *Harrar*

398. Timbers of the World. A study of the properties of various grou of tropical and temperate zone woods with particular emphasis upon those us in marine construction, and for lumber, plywood decorative paneling, and furnitu Prerequisite: Forestry 290 or equivalent. 2 units. *Harrar*

Ecology

243. Natural Resource Ecology. An introduction to modern ecology applied to natural resource management and environmental protection. Emphas put on the ecosystem as the basic unit of management. Prerequisite: permission instructor. 3 units. *Wuenscher*

341. Ecological Principles in Environmental Management. Discussio of the application of ecological principles to environmental manipulation. Metho of planning and managing human use of ecosystems while avoiding environment deterioration. Stress put on the biological viewpoint. Prerequisites: general ecolog and Forestry 243 or other substantive course work in ecology. 3 units. *Wuensche*

345, 346. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and researc topics related to the management of natural resources. 1 unit per semester. *Sta*

347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and researc topics related to the management of natural resources. 1 unit per semester *Knoerr and Wuenscher*

354. Quantitative Analysis of Ecological Environmental Systems. (Se description under Statistics and Operations Research.)

Entomology

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laborator work with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

230. Forest Entomology. Identification, biology, and control of insect that cause damage to trees and wood products. Emphasis of diagnosis is on th characteristics of the damage and the stages of the insects responsible. Prerequisite Forestry 222 or equivalent or consent of instructor. 3 units. *Anderson*

233. General Entomology. Principles of morphology, physiology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoolog or consent of the instructor. 4 units. *Anderson*

331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. 3 units. *Anderson*

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects with emphasis on how both the abiotic and biotic ements influence the fluctuation of forest insect populations. Prerequisite: one urse in entomology or zoology or consent of the instructor. 3 units or 4 units with oratory. *Anderson*

335. Entomological Research Techniques. Problem analyses, scientific iting, and laboratory and field research methods which are especially applicable entomological problems. 1 unit. *Anderson*

385. Seminar in Forest Protection. Discussion of current problems in tomology and pathology and evaluation of topical research for protection and ntrol application in forest resource management. Prerequisites: Forestry 223 and 0. 1 unit. *Anderson and Stambaugh*

thology

222. Biology of Forest Insects and Diseases. (See description under ntomology.)

223. Forest Pathology. Infectious and non-infectious diseases of forest ees, and related deterioration of forest products. Field and laboratory study of mptoms, etiology, and control. Prerequisites: Biology 11 and 12 or equivalent. units. *Stambaugh*

321. Phytopathological Technique in Forestry. Fundamentals of phyto- thology and their application to field and laboratory investigations of tree diseases d wood degradation; biological interpretation of host-pathogen-environment teraction is stressed in literature review, experimentation, and scientific writing. erequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*

322. Microbiology of Forest Soils. Qualitative and quantitative charac- rization of the microbial populations of forest soils with emphasis on rhizosphere teractions in root pathogenesis and mycorrhizal development; epidemiology of ot diseases of trees; principles of control. Prerequisites: Forestry 223; mycology bacteriology is recommended. 3 units. *Stambaugh*

385. Seminar in Forest Protection. (See description under Entomology.)

hysiology and Biochemistry

201. Tree Physiology. A general survey of the major physiological pro- sses in trees and other plants, including food synthesis, growth and water rela- ons. Special project and term paper required. Lectures, laboratories, and read- gs. Prerequisite: permission of instructor. 3 units. *Hellmers*

205. Tree Growth and Development. Life processes, growth, and develop- ent of trees, with emphasis on physiological processes and environmental in- ences on structure, composition, and function. 3 units. *Barnes*

207. Chemistry of Woody Tissues. Composition of wood at the elemental, olecular, and macromolecular levels; both in woody plants and in processed oods. Distribution and properties of main components, and methods of analysis. rerequisite: organic chemistry or consent of instructor. 3 units. *Barnes*

208. Physiology of Wood Formation. Processes involved in the growth d development of woody tissues, including internal control mechanisms and ef- cts of environmental stresses on structure and composition. Prerequisite: Forestry 01 and 241 or equivalents. 3 units. *Barnes*

225. Chemical Aspects of Forest Protection. Chemical aspects of orga isms attacking trees and of materials used in their control. Emphasis on structu and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 uni *Barnes*

305. Forest Tree Biochemistry. Study of the biological synthesis, functi and degradation of the main biochemical constituents of trees. Emphasis on cel lose and other cell-wall polysaccharides, lignins, terpenes, and phenolics and oth extractives. Prerequisites: Forestry 201 and a course in biochemistry. 3 uni *Barnes*

ENVIRONMENTAL SCIENCE

Soils

261. Forest Soils. Origin, development, and classification of soils wi special emphasis on those developed in humid climates; morphological, physic and chemical properties of soils in relation to growth of trees; effect of forests soils. Prerequisites: Chemistry 1 and 2, and Physics 1, or equivalents; physic geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 uni *Ralston*

362. Forest Soil Physics. Analysis of the physical properties of s related to the growth and development of forest trees. Consideration is given the significance of soil moisture, temperature, aeration, and structural characteristi in the analysis of forest growth relationships. Prerequisite: Forestry 261. 3 uni *Ralston*

364. Soil Classification and Mapping. Classification of soils as natu bodies. Mapping of soils, land use classes, and forest site classes; field study w be made of soils in either the coastal plain or mountains. Prerequisite: Forest 261. 3 units. *Ralston*

366. Forest Soil Fertility. The relationships of soil fertility factors in t growth of forest trees. Emphasis is placed on the analysis of soil factors related the mineral nutrition of trees. Prerequisite: Forestry 262; analytical chemistry recommended. 3 units. *Ralston*

Meteorology

203. General Meteorology. A general introduction to the science of met orology, particularly for students concerned with problems in biology and hydr ogy. Emphasis is placed on the fundamentals and role of atmospheric therm dynamics and energy and mass transfer processes in determining both local a regional aspects of weather and climate. 3 units. *Vukovich*

204. Microclimatology. Introduction to the micrometeorological processe Discussion of the integration of these processes and the resulting microclimates the rural (forest, field, and water surface) and urban environments. Methods f modification of the microclimate. 3 units. *Knoerr*

215. Air Pollution Meteorology. The theory of transport and diffusi of air pollutants and its application to practical problems and computations invol ing both single sources and multiple sources, including urban communities; mode ing of transport and diffusion, both in wind tunnels and computers; stack desi from the meteorological point of view; the organization of meteorological networ ıd field studies; the measurement, monitoring and equipment requirements of per- ıent meteorological parameters; air pollution climatology; meteorological manage- ent of air pollution. Prerequisite: introductory course in general meteorology orestry 203 or equivalent). (Course sponsored by Triangle Universities Con- ırtium on Air Pollution and taught by faculty from North Carolina State Univer- ty). 3 units. *Staff*

217. Environmental Instrumentation. Consideration of the physical basis ır measuring parameters of natural and controlled environments. Properties and fective utilization of contemporary electronic measurement and data acquisition stems, including transducers, signal conditioners, and analog and digital record- s. Methods for obtaining and processing computer compatible records. Precision easurement and calibration techniques with primary and secondary laboratory andards. Two lectures and three laboratory hours per week. Prerequisites: con- nt of the instructor; students should have a basic knowledge of the properties of ıvironmental parameters and be able to write computer programs. 3 units. *noerr*

304. Atmospheric Turbulence and Diffusion. Bulk and molecular aspects atmospheric turbulence. Navier-Stokes equations and the Reynold's stresses. lixing-length and statistical turbulence theories. Similarity hypotheses. Turbulent ansfer and diffusion in adiabatic and diabatic atmospheres. Characteristics of ırbulence in various scales of motion from the planetary to sub-inertial range. rerequisites: Forestry 203 and differential equations or consent of instructor. Offered on sufficient demand.) 3 units. *Vukovich*

306. Dynamics of Local Atmospheric Motion. Characteristics of atmos- ıeric motion in the 100 m to 100 km scale. Analytic development from hydro- ynamic and thermodynamic equations, incorporating appropriate scale forcing ınctions of heating and terrain roughness. Theory and characteristics of land and a breezes, mountain and valley breezes, mountain waves and local modification large scale atmospheric motion. Prerequisites: Forestry 203 and differential quations or consent of instructor. (Offered on sufficient demand.) 3 units. *ukovich*

344. Micrometeorology. Physics of the earth's surface environment with mphasis on plant and animal microclimates: budgets of mass, momentum and ıergy; vertical structure of wind, temperature, water vapor and carbon-dioxide in lation to exchange processes within the biosphere; local circulation and eddy iffusion; principles of micrometeorological measurement. Prerequisites: Forestry 03 or equivalent, and calculus. (Offered on sufficient demand.) 4 units. *Knoerr*

ydrology

216. Watershed Hydrology. Influence of vegetation, soil types, and land ɔrms on water yield, water quality, and flood potential. Analysis of precipitation atterns, infiltration rates, erosion forces, and sediment carrying capacities of treams. Techniques and research methods used to control the hydrologic cycle, vater quality and water yield on wild lands. 3 units. *Hellmers*

342. Hydrologic Processes. Physical processes of the hydrologic cycle vith emphasis on those processes which can be modified or controlled by watershed nanagement. (Offered on sufficient demand.) 3 units. *Knoerr*

RESOURCE ECONOMICS AND POLICY

269. Resource Economics and Policy. Development and critical revi of concepts useful in understanding and eva'uating the distribution of natural source use over time in terms of the relations between technological knowled group and individual behavior, and social institutions. 3 units. *Convery*

270. Economics of Forestry. Development of the principles of econom useful in the analysis of the past, present, and prospective supply and dema situations for forestry goods and services; problems of the economics of the fi and industry, basic and peculiar to forestry, with special attention to the ti dimensions of value; the role of forestry in the general economy including atte tion to relevant institutional factors. Prerequisite: Forestry 269 or one cou in the principles of economics. 3 units. *Convery*

377. Seminar in Natural Resource Allocation and Efficiency. Evaluati of economic principles concerned with problems of natural resource allocati with special attention to the alternatives for governmental policies in private pro erty economics. Prerequisite: an advanced level course in non-market decisio making or Forestry 378 or its equivalent. 2 units. *Convery*

378. Seminar in Forest Economics. Examination and discussion of t application of economic concepts in forestry, the potential contribution of econom analysis to private and public forest management; current research in forest ec nomics. Prerequisite: Forestry 270 and 379 or consent of the instructor; advanc courses in economics and economic theory are desirable. 2 units. *Convery*

STATISTICS AND OPERATIONS RESEARCH

210. Analytical Techniques in Forest Utilization. Introduction to utili tion in the managed forest and principal wood-using industries and to operati analysis methods applied to scheduling and production problems in the industries. 3 units. *Yandle*

250. Biometry. Concepts and methods of statistics essential to the colle tion, analysis, and interpretation of resource and biological data. Emphasis placed on problems of estimation, inference, and decision-making with expe mental data. 3 units. *Yandle*

251. Theory and Methods for Sampling Biological Populations. Intr ductions to statistical methods for sampling natural resources and biologic populations. Simultaneous consideration is given to theoretical and experiment problems in the design and applications of sampling methods and in the interpret tion of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 uni *Yandle*

253. Computer Science in Natural Resources. Components and orga zation of a computer system; automatic programming languages; storage a retrieval systems (TSAR); equation fitting by iteration and least squares method graphical techniques. 1 unit. *Chapman*

258. Operations Research. Mathematical model formulation and develo ment of techniques to aid decision-making in problems of natural resource alloc tion and use. Includes the theory and techniques of inventory control, equipme replacement planning, queuing theory, competitive strategies, allocation, sequen ng and dynamic programming. Consideration is given to both deterministic and on-deterministic models. 3 units. *Staff*

352. Theory and Applications of Linear Statistical Models. Theoretical evelopment of the general linear statistical model together with extensions to acommodate linear approximation of non-linear cases. Curve fitting techniques are eveloped with emphasis on applications to natural phenomena. Prerequisite: onsent of the instructor. 3 units. *Chapman*

353. Design and Analysis of Experiments. Extension of the theory of stimation and testing for general linear models to include the less than full ank case. Experimental design models such as factorial and incomplete block models are developed as special cases of the general theory. Emphasis is placed on field and laboratory designs together with appropriate computerized analysis echniques. Prerequisite: Forestry 352. 3 units. *Chapman*

354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of haracteristics and dynamic behavior of biological populations; development and valuation of mathematical models for ecological, physiological, and environmental ystems. Simulation techniques for ecosystem analysis will be considered. Preequisites: Forestry 204, 243, 253, and 353. 3 units. *Chapman, Yandle, and Staff*

SPECIAL STUDIES AND RESEARCH

299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students offered in the areas of forestry nd related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in he following branches of forestry and related natural resources. Credits to be arranged.

1. *Forest Ecology*. Prerequisite: Forestry 243 or equivalent. *Wuenscher*
2. *Forest Soils*. Prerequisite: Forestry 261 or equivalent. *Ralston*
3. *Silviculture*. Prerequisites: Forestry 243 and 244 or equivalents. *White*
4. *Forest Management*. Prerequisite: Forestry 281 or equivalent. *Staff*
5. *Forest Economics*. Prerequisite: Forestry 270 or equivalent. *Staff*
6. *Wood Anatomy and Properties*. Prerequisites: Forestry 241 and 290 or equivalents. *Harrar*
7. *Forest Mensuration and Biometry*. Prerequisites: Forestry 250 and 352 or equivalents. *Chapman*
8. *Forest Entomology*. Prerequisite: Forestry 230 or equivalent. *Anderson*

9. *Forest Operations Research.* Prerequisite: consent of instruct *Yandle*

10. *Dendrology.* Prerequisite: Forestry 241 or equivalent. *Harrar a White*

11. *Forest-Tree Physiology.* Prerequisites: plant physiology and pla or forest ecology. *Barnes, Hellmers, and Kramer*

12. *Forest Pathology.* Prerequisites: plant physiology and Forestry 2 or equivalents. *Stambaugh*

13. *Forest Meteorology and Hydrology.* Prerequisites: Forestry 20 342, or equivalents. *Knoerr*

14. *Forest Biochemistry.* Prerequisites: plant physiology and orga chemistry. *Barnes*

368. Field Seminars. Field studies, consultations, and visits to areas interest during spring vacation period or at other times, in the several branch of forestry and related natural resources listed under Forestry 357, 358. Credits be arranged. *Staff*

RELATED COURSES IN OTHER DEPARTMENTS

Many courses available in other departments of the University are relat to the biological, environmental, economics and policy, and biometrics and oper tions research areas of forestry and other natural resources. These courses offer in botany, zoology, biochemistry, chemistry, physics, engineering, mathematic economics, business administration, sociology, and political science may be utiliz by graduate students in the School of Forestry. For a specific listing of pertine courses available in other departments see the *Bulletin of the School of Forestr*

The University Program in Genetics

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology an Immunology), Buettner-Janusch (Anatomy and Zoology), and Guild (Biochemi try); Associate Professors Antonovics (Botany), Boynton (Botany), Gillha (Zoology), Kelley (Medicine and Biochemistry), C. Ward (Zoology), and Webst (Biochemistry); Assistant Professors Hall (Biochemistry), Harriman (Biochemi try), Kredich (Medicine and Biochemistry), Luftig (Microbiology and Immuno ogy), and F. Ward (Microbiology and Immunology)

The University Program in Genetics provides a coherent course of stud in all facets of biology related to genetics. Graduate students registered in an of the biological sciences departments may apply to the faculty of the genetic program to pursue study and research leading to an advanced degree. It woul be helpful if applicants for admission to the Graduate School indicated their in terest in the genetics program at the time of application. Requests for informatio describing more completely the research interests of the staff, facilities, and speci stipends and fellowships should be addressed to the Director, Genetics Pro gram (Nanaline H. Duke Building, Room 151).

For Seniors and Graduates

204. Introductory Genetics. An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organizatio of the genetic material. Primarily for medical students but graduate students ma

: admitted with the instructor's permission. (Listed as Biochemistry 204.) 2 units. *ross and Staff*

215. Bacteriophage: Structure and Function. Classical experiments of uria, Hershey, and Delbrück. Timing of events during infection. Morphogenesis component substructures and their subsequent assembly into mature virions. nalysis of electron micrographs. Interactions of bacteriophage with host-cell walls ıd membranes. These areas will be covered in the context of coliphages. (Also sted as Microbiology and Immunology 215.) Fall semester. 2 units. *Luftig and ichols*

216. Molecular Genetics. An advanced course on genetic mechanisms ıd their relationship to nucleic acids. Prerequisites: introductory courses in bio-ıemistry and genetics. (Also listed as Biochemistry 216.) 3 units. *Guild and Staff*

236. Human Genetics. Particular emphasis upon the uniqueness of udies in human biochemical and population genetics. Prerequisite: Anatomy 231 Anthropology 231. Zoology 131). or an elementary course in biology including :netics, or permission of instructor. (Also listed as Anatomy 236. Anthropology 36, and Zoology 236.) 3 units. *Buettner-Janusch*

280. Principles of Genetics. An introduction to the structure and proper-:s of genes and chromosomes and to the evolution of genetic systems. Prerequi-tes: introductory courses in biology, chemistry, and mathematics. (Also listed as otany 280 and Zoology 280.) 3 units. *Antonovics, Boynton, and Gillham*

282. Experimental Genetics. A series of laboratory exercises and discus-ons on the molecular mechanisms of mutation, recombination, replication, trans-iption, and translation of the genetic material. May be taken concurrently with enetics 280. Prerequisite: consent of instructor. (Also listed as Biochemistry 32.) 2 units. *Harriman and Staff*

284. Current Topics in Genetic Mechanisms. A seminar and lecture ourse devoted to the analysis of the current literature in molecular genetics. Given ı response to adequate demand. Prerequisites: Genetics 280 or its equivalent and onsent of instructor. (Also listed as Biochemistry 284.) 1 unit. *Hall and Staff*

285. Population Genetics and Evolution. A seminar and lecture course evoted to the analysis of the current literature in population genetics and evolution. rerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also sted as Botany 285.) 2 units. *Antonovics and Staff*

288. The Cell in Development and Heredity. A seminar on topics of urrent interest and controversy. Prerequisite: a course in genetics and permission f one instructor. Alternates with Anatomy 244 and Zoology 244. (Also listed s Anatomy 288 and Zoology 288.) *Counce, Gillham, and Staff*

'or Graduates

336. Immunogenetics. Antigens of tissues and organs, distribution, extrac-ion, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Test or histocompatibility including lymphocyte interaction and reactivity. Change in ntigenicity and immune responsiveness in carcinogenesis. Immunologic factors ı pregnancy and in homotransplantation of organs. (Also listed as Microbiology nd Immunology 336.) 2 units. *Amos and Ward*

351-352. Genetics Seminar. Required of all students specializing in gen ics. (Also listed as Biochemistry 351-352.) 1 unit per semester. *Harriman a Staff*

Geology

Professor Heron, *Chairman* (119 Science Building); Associate Professor Perkin *Director of Graduate Studies* (111 Science Building); Associate Professors Furbis Lynts, and Pilkey; Adjunct Assistant Professor Macintyre

The Department of Geology offers graduate work leading to the A.M. degre An undergraduate degree in geology is not a prerequisite for graduate studies, bı a student must have had or must take a summer field geology course (or equivale experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and stru tural geology. In addition he must have had one year of college chemistry, one ye of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide sp cialized training in the fields of oceanography, sedimentology, stratigraphy, pal ontology, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for th A.M. degree.

For Seniors and Graduates

205. Geological Oceanography. The study of the broad geologic aspect of the ocean basins, including origin, bottom physiography, sediment distributior and sedimentary process. Observations in the field will be emphasized and wi include training in sampling procedures for both shallow and deep water. Thi course is not open to students who have completed Geology 206. (Given at Beaufort only.) 6 units. *Pilkey*

206. Principles of Geological Oceanography. A broad survey of man geological aspects of the oceans including sediment types, processes of sedimentation, geological structures of the ocean basins, and bottom physiography. Prerequisite: Geology 213 or consent of instructor. 3 units. *Pilkey*

208. Shallow-Marine Geology. Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marin environment. Prerequisite: Geology 108 or consent of instructor. 3 units. *Perkin.*

211. Stratigraphic Principles and Applications. Survey of stratigraphi principles with an emphasis on their application to the solution of stratigraphi problems. Discussions of case histories from the literature. Prerequisite: Geolog 108. 3 units. *Perkins*

213. Sedimentology. The parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisites: Geology 108 or consent of instructor. 3 units. *Pilkey*

214. Sediments in Thin Section. The study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Interpretation of rock textures and their genesis will be emphasized. Prerequisites: Geolog 213 or consent of the instructor. 3 units. *Perkins*

222. **Sedimentary Minerals.** Structure and geologic occurrences of selec- ve detrital and authigenic minerals including the clay minerals. Theory and use f X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. rerequisites: Geology 102 or consent of instructor. 3 units. *Heron*

*229. **Economic Geology.** An analysis of the principles and processes in- olved when elements are concentrated to economic proportions in magmatic, meta- orphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geol- gy 102. 2 units. *Furbish*

230. **Principles of Structural Geology.** Description, origin, and interpre- tion of primary and secondary geologic rock structures. Prerequisites: Geology 06 and 108. Given biennially. 3 units. *Furbish*

241-242. **Invertebrate Paleontology.** Biologic and stratigraphic relation- ips of fossil invertebrates, with special emphasis on evolutionary trends of vertebrates as interpreted from fossil evidence. Prerequisites: Geology 2 or nsent of instructor. Given biennially. 3 units per semester. *Lynts*

243-244. **Micropaleontology.** Microscopic animal and plant fossils, exclu- ive of spores and pollen, with special emphasis on their biology, taxonomy, volution and stratigraphic distribution. Prerequisite: Geology 242 or consent of structor. Given biennially. 3 units per semester. *Lynts*

247. **Paleoecology.** Application of ecologic and geologic principles to the econstruction of the interrelationship between organisms and their environment in eologic time. Prerequisites: Geology 213, 242 or consent of instructor. Given iennially. 3 units. *Lynts*

or Graduates

*300. **Seminar in Oceanography.** 1 to 3 units. *Staff*

305. **Seminar in Continental Drift and Global Tectonics.** Given bien- ially. 3 units. *Lynts*

*310. **Seminar in Stratigraphy.** 1 to 3 units. *Staff*

*312. **Seminar in Sedimentology.** 1 to 3 units. *Staff*

*320. **Seminar in Mineralogy.** 1 to 3 units. *Staff*

*330. **Seminar in Geochemistry.** 1 to 3 units. *Staff*

*340. **Seminar in Paleontology.** 1 to 3 units. *Staff*

*350. **Seminar in Geomathematics.** 1 to 3 units. *Staff*

*371, 372. **Advanced Topics in Geology.** To meet the individual needs of graduate students for independent study in various environmental sedimentary fields. 1 to 3 units. *Staff*

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* Offered on demand.

Germanic Languages and Literature

Professor Phelps, *Chairman and Director of Graduate Studies* (102 Foreign Lar guages); Professor Salinger; Associate Professor Borchardt; Assistant Professo Alt, Novak, and Stern

The Department of Germanic Languages and Literature offers graduat work leading to the A.M. degree. Students who expect to major in German shoul have had sufficient undergraduate courses in Germanic languages to enable ther to proceed to more advanced work.

Students who wish to take courses in German as a related field shoul normally have completed a third-year course (in exceptional cases, a second-year of college German with acceptable grades.

For Seniors and Graduates

201, 202. Goethe. A study of his life and works in the light of his lastin significance to Germany and world literature. First semester: lyrics. prose fictio and selected dramas; second semester: *Faust*, I and II. 3 units per semeste *Novak, Phelps, and Salinger*

203, 204. Eighteenth Century. Eighteenth-century German literature i its relation to European intellectual currents of that time. 3 units per semeste *Phelps*

***205, 206. Middle High German.** The language and literature of Ge many's first classical period. 3 units per semester. *Stern*

***207, 208. German Romanticism.** The principal writers of the period German Romanticism from 1800 to 1850. 3 units per semester.

209, 210. Kleist, Grillparzer, and Hebbel. The development of the dram in Germany and Austria between Schiller and Naturalism. 3 units per semeste *Alt and Salinger*

211, 212. Nineteenth-Century Literature. From the end of Romanticis through Realism. 3 units per semester. *Alt*

213. Heinrich Heine. A study of the German poet and his impact upo his age. 3 units. *Salinger*

214. The Twentieth Century. Literature from the turn of the century t the present through representative authors. 3 units.

***215. Seventeenth-Century Literature.** A study of the leading writers the Baroque, viewed against the background of their time. 3 units. *Borchar*

216. History of the German Language. The development of the phono ogy, morphology, and syntax of German from earliest beginnings to the presen 3 units. *Stern*

***217. Renaissance and Reformation Literature.** The period from 140 to about 1600. 3 units. *Borchardt*

* Offered on demand.

***218. The Teaching of German.** A survey of modern teaching techniques: roblems in the teaching of German on the secondary and college levels. Analysis nd evaluation of textbooks and related audiovisual materials. 3 units. *Phelps*

***219. Applied Linguistics.** The application of modern linguistic principles a systematic study of the phonetics, morphology, and syntax of modern German. rerequisite: permission of the instructor. 3 units. *Stern*

***232. Criticism and Literary Theory.** Critical concepts, craft of interretation, and readings from the great critics. 3 units. *Alt and Borchardt*

***233. Advanced Composition.** Intensive study of syntax; practice in the riting of German prose, aiming toward the development of an expressive and uent style. 3 units.

or Graduates

***301. Gothic.** 3 units. *Stern*

***316. The Austrian Novel from 1930 to the Present.** Studies in the novels f Hermann Broch, Robert Musil, and Heimito von Doderer. 3 units. *Salinger*

321, 322. Germanic Seminar. 3 units per semester. *Alt, Phelps, Salinger, nd Stern*

——. Graduate Reading Course. An intensive course in German to develop rapidly the ability to read German in several fields. Graduate students only. o credit.

elated Courses in Other Departments

The following courses in other departments are recommended to students ho are majoring in Germanics, as particularly valuable in building a proper ackground for Germanic studies.

a. Graduate courses in foreign or comparative literature or philology, offered y the ancient and modern language departments, to be selected after consultation ith the Germanic Languages Department.

b. Graduate courses in history and philosophy, offered by those departnents, to be selected after consultation with the Germanic Languages Departnent.

Health Administration

Associate Professor Jaeger, *Chairman* (263 Baker House); Assistant Professor Smith, *Director of Graduate Studies* (234-B Baker House); Associate Professor Swanson; Adjunct Professor Gentry; Adjunct Assistant Professor Kaluzny

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-one-month academic program that leads to the M.H.A. degree. The academic portion is composed of five continuous semesters of graduate work of which 36 units are within the department, 39 units are in other departments of the Graduate School (30 of these units are in courses offered through the Graduate School of Business Administration). Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experien that is conducted under faculty supervision and is individually designed arou each student's interests. For students without previous administrative experienc the residency should be considered an integral part of the M.H.A. progra Admission to this program is based upon suitability of the candidate to assu leadership roles in the organization and management of the delivery of heal services, as well as on capability for graduate study. As requirements for part cipation differ somewhat from the basic admission requirements of the Gradua School, interested individuals should obtain complete information about the pr gram directly from the Chairman.

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* Offered on demand.

301. The Health System and Its Environment. An introduction to th organization and management of health services from a systems perspectiv Emphasis is on the evolution of the present system and on the interplay of forc within the system and between the system and its environment. 3 units.

312. Comparative Health Systems. A comparative examination of th structure and performance of the health systems of the United States and oth countries, particularly Canada and Great Britain. Topics include current financin capitalization, utilization, control, and the relative roles of the governmental an private sectors. 3 units.

322. Public Policy and Health Care. A study of the development an present status of selected public policy issues within their social, economic, an political contexts. Alternative courses of possible public action are reviewed an their probable outcomes are assessed. 3 units.

324. Institutional Health Services. A broad examination of the provisio of health services in institutional settings. The principal focus is on the gener hospital, but attention is also given to the mental hospital and other long-ter care institutions. Specific study is made of the administrative and information organization; the structure and function of each department; relationships betwee administration and the governing board, the medical staff, and the community operational and capital financing; the planning function; and the evaluation o performance. 6 units.

329-339-349. The Practicum. The practicum is designed to provide th students an opportunity to experience and develop perspective on the interplay o various forces and problems within the field of health services delivery. Each student rotates through six different settings that are selected as focal points fo significant combinations of people, problems, and resources. Within each settin the student, under faculty supervision, is responsible for the conduct of certai administrative functions in order to increase his ability to solve real problems an improve personal judgment. 2 units each in the summer, fall, and spring semesters

335. Ambulatory Health Services. This course covers the non-institutiona components of the organization and provision of personal health services. Th principal emphasis is on medical group management, including forms of organization, financing of services, physician-patient relationships, medical records, an peer review. Other topics include dental care, home care, half-way houses, multiphasic screening, and community health and mental health centers. 3 units.

346. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rathe ıan individuals. Coverage includes aspects of environmental and occupational ygiene, nutrition and housing, planning community health services, preventive ealth education and programs, and other public health activities. Included are the roblems associated with health status measurement and assessment. 3 units.

348. Legal and Regulatory Constraints on Health Services. This course eats the legal relationships between elements of the health system and the larger ociety of which it is a part. Attention is devoted to the certification, operation and erformance of health manpower, organizations, and services, and the difficulties ı establishing effective restraints to minimize undesired results. The approach to ıe course includes the study of selected legislation, court cases, and research ndings that assist in understanding formal constraints that affect the operation of ıe health system. 3 units.

350. The Administrative Residency. The administrative residency is inividually designed and provides participatory experiences in various components f the health system. The purposes are to broaden the student's knowledge of the peration of the system and to improve the student's ability to utilize skills deeloped during the academic phase of his training. During the twelve-month esidency, the student rotates through three general areas: a broad systems exposure 3 months); an organization of secondary interest (3 months); and an organizaon of primary interest (6 months). The systems exposure includes a field experince with the Hospital Section of the Duke Endowment and other broadly oriented gencies in the health field. Examples of interest areas include: general and special ospitals, nursing homes, clinics, health maintenance organizations, mental health rganizations, health departments, prepayment plans, and planning agencies. Durıg this period the student is provided a stipend. Credits to be arranged. 0-3 units.

360. Seminar in Health Administration. A series of seminars held at the nd of each quarter during the administrative residency. The seminars are designed ı complement the experience obtained during the residency and to add depth to ıe material covered during the academic phase of the program. Credits to be rranged. 0-3 units.

371, 372. Directed Research. Credits to be arranged.

History

Professor Colton, *Chairman* (235 Allen); Professor Young, *Director of Graduate Studies* (237 Allen); Professors Alden, Durden, Ferguson, Holley, Hollyday, Lerner, Oates, Parker, Preston, Ropp, A. Scott, W. Scott, Silberman, TePaske, and Watson; Associate Professors Acomb, Brieger, Cell, Davis, Mauskopf, and Witt; Assistant Professors Chafe, Gavins, Goodwyn, Hartwig, Miller, and Nathans

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge ıf at least one ancient or modern language related to his program of study and have completed successfully either a research paper (approximately fifty to sixty documented pages) or two related, chapter-length papers (approximately twenty-five to thirty documented pages each), normally the product of a year's seminar or wo semester-courses. The paper or papers must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15;

those anticipating a September degree must have their papers read and approve by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepar himself for examination in four fields. Three shall normally be history. The choic of fields is determined in consultation with the student's supervisor and the Directo of Graduate Studies. The department offers graduate instruction in the fields o Africa, Afro-American history, ancient history, medieval Europe, early modern Europe, recent Europe, American history, English Renaissance, Modern Britain British Empire and the Commonwealth, pre-revoluntionary Russia, revolutionary Russia, Latin America, South Asia in the modern period, traditional China, modern China, traditional Japan, modern Japan, military history, history of science, history of medicine, and historiography. The candidate for the Ph.D. degree must normally have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative would normally take the form of successfully completed formal training in an auxiliary discipline (such as statistics or social science methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Students may receive credit for either semester of a hyphenated course without taking the other semester if they obtain written permission from the instructor and the Director of Graduate Studies.

For Seniors and Graduates

201-202. History of Russia, 1801-1917. Origins and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of political parties. 6 units. *Miller*

207-208. Urban History of the United States. Urbanization in the United States since the Colonial period. Each student is responsible for the history of a particular city, with attention to the emerging methodology of urban studies. 6 units. *A. Scott*

209-210. Selected Topics in Afro-American History, 1619-Present. Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. 6 units. *Gavins*

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. 3 units. *Watson and Staff*

215-216. The Diplomatic History of the United States. 3 units per semester. *Davis*

219. Historical and Contemporary African Society. Identification of political, social, and economic themes. 3 units. *Hartwig*

221-222. Problems in the History of Late Medieval and Early Modern Europe. 6 units. *Witt*

223-224. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth and eighteenth century Europe, with emphasis on France and the French Revolution. 6 units. *Acomb*

227-228. Recent U.S. History: Major Political and Social Movements. 6 units. *Chafe*

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. 3 units. *Parker*

230. The History of Spain. From the late medieval period to the present. 3 units. *TePaske*

231-232. The Hispanic Colonies and Republics in America. First semester: the Spanish Conquest, the church, race, and society; the development of universities, medicine, and science. Second semester: the wars of independence, the Mexican revolution since 1910, problems of land, education, and public health. 6 units. *TePaske*

233, 234. The Institutional, Cultural, and Social History of Hispanic America. 3 units per semester.

237-238. Europe in the Middle Ages, 395-1500. 6 units. *Young*

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and the musical and artistic traditions. 3 units. *Hartwig*

241-242. Modernization and Revolution in China. 6 units.

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation with special emphasis on changes in social and economic life. 3 units.

248. History of Modern India and Pakistan, 1857 to the Present. 3 units.

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. 6 units. *Holley*

253-254. Modern European Intellectual History. 6 units. *Parker*

255-256. Problems in African History. 6 units. *Hartwig*

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and policies of the Soviet state. 6 units. *Lerner*

263-264. American Colonial History and the Revolution, 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. 6 units. *Alden*

265-266. Modern South America. Political, social, and economic history of leading South American nations from the mid-nineteenth century to the present. 6 units. *TePaske*

267-268. From Medieval to Early Modern England. The intellectual, social, and political problems of the transition to modern England, with special emphasis on the English Renaissance. 6 units. *Ferguson*

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class-consciousness, Victorianism, and the impact of war in the twentieth century. 6 units. *Cell*

273, 274. Topics in the History of Science. Studies of critical stages in the evolution of scientific thought as well as of their intellectual context. 3 units per semester. *Mauskopf*

275-276. Central Europe, 1849-1914. Conflict between liberalism and authoritarianism, clash of nationalities, and domestic changes in Germany and Austria-Hungary. 6 units. *Hollyday*

277-278. The Era of the Civil War in the United States and Its Aftermath, 1820-1900. 3 units per semester. *Durden*

279. Oral History. Techniques of oral history applied to the study of racial attitudes and problems in the United States. 3 units. *Goodwyn*

281-282. Development of Modern Medicine. 3 units per semester. *Brieger*

283-284. Political and Social Change in the United States, 1789-1860. 3 units per semester. *Nathans*

287-288. History of Modern Japan. Political, economic, and social development of Japan since 1750 with emphasis on factors contributing to Japan's emergence as a modern state. 3 units per semester. *Silberman*

290. East African History. Examination of major issues and research problems. 3 units. *Hartwig*

296. Canada from the French Settlement to the Present. Selected problems in the development of Canada and its provinces. 3 units. *Preston*

297. The British Empire in the Nineteenth Century (from 1783). The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. 3 units. *Preston*

298. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anticolonialism. 3 units. *Preston*

ANCIENT HISTORY

For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

For Graduates

305-306. Seminar in British History. 3 units per semester. *Ferguson*

307-308. Seminar in United States History. 3 units per semester. *Davis Durden, Holley, and Watson*

309-310. Seminar in American Colonial and Revolutionary History. 3 units per semester. *Alden*

317-318. Seminar in the History of Western Europe. 3 units per semester. *Colton, Parker, and Scott*

337-338. Seminar in Medieval History. 3 units per semester. *Young*

343-344. Seminar in the History of American Foreign Relations. 3 units per semester. *Davis*

347-348. Seminar in Modern India. 3 units per semester.

353-354. Seminar on the Second British Empire and the Commonwealth of Nations. 3 units per semester. *Preston*

361-362. Seminar in the History of Russia. 3 units per semester.

371-372. Research Seminars. Offered in conjunction with colloquia listed below. 3 units per semester.

401. Seminar on the British Commonwealth. 3 units. *Braibanti and Preston*

Colloquia for Graduates

Each colloquium described below deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371.1-372.1, etc.

351.1-352.1. Military History. 3 units per semester. *Ropp*

351.2-352.2. Modern European Intellectual and Cultural History. 3 units per semester. *Parker*

351.10-352.10. Medieval Europe. 3 units per semester. *Young*

351.15-352.15. The English Renaissance. 3 units per semester. *Ferguson*

351.25-352.25. Central Europe, 1849-1914. 3 units per semester. *Hollyday*

351.30-352.30. European Diplomatic History Since 1870. 3 units per semester. *W. Scott*

351.31-352.31. Twentieth-Century Europe. 3 units per semester. *Colton*

351.40-352.40. City and Frontier in United States History. 3 units per semester. *A. Scott*

351.45-352.45. Reform and Politics in Nineteenth-Century America. 3 units per semester. *Durden*

351.46-352.46. Twentieth-Century United States to 1941. 3 units per semester. *Watson*

351.47-352.47. Diplomatic History of the United States. 3 units per semester. *Davis*

351.51-352.51. Hispanic America. 3 units per semester. *TePaske*

351.60-352.60. Soviet History. 3 units per semester. *Lerner*

351.65-352.65. Modernization and Revolution in China. 3 units per semester.

351.70-352.70. Modern South Asia. 3 units per semester.

Historiography and the Teaching of History—For Graduates

312. Seminar in the Teaching of History in College. The work in this course is intended to acquaint students with the problems involved in teaching history in college. It includes classroom observation and some teaching experience. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. Year course. No credit. *Holley and Watson*

314. Historical and Social Science Methodology. Methods used in historical research with emphasis upon the various social science approaches. 3 units. *Chafe and Silberman*

320. Historiography. A study of the great historians from Herodotus to Henry Adams and the new social science and humanities approaches to history. 3 units. *Parker*

History 314 or History 320 is required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke University.

Marine Sciences—The University Program

Professor Costlow, *Director;* Professors Bookhout (Zoology) and Johnson (Botany); Associate Professors Barber (Zoology and Botany), Pilkey* (Geology), and Searles* (Botany); Assistant Professors Baier (Chemistry), Forward (Zoology), Gutknecht (Physiology), Sullivan (Biochemistry), and Sutherland (Zoology)

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are Botany, Chemistry, Geology, and Zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University *Marine Laboratory Bulletin.* The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

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* In residence at the Marine Laboratory during the summer only.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Duke University *Marine Laboratory Bulletin* for the current schedule of courses.

S202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. *Salmon (University of Illinois)*

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra- and inter-specific relationships; community ecology. Readings, discussions, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology, or the equivalent, and a year of mathematics; some knowledge of statistics will be helpful. (Given at Beaufort.) (Also listed as Zoology 203.) 6 units. *Sutherland*

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary process. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. (Given at Beaufort only.) (Also listed as Geology 205.) 6 units. *Pilkey*

S205. Introductory Marine Microbiology. The biology of microorganisms in oceans and estuaries. Prerequisite: one year of college biological science. (Also listed as Botany 205.) 6 units. *Johnson and Searles*

211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. (Also listed as Botany 211.) 6 units. *Searles*

212. Marine Membrane Physiology. Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course will include the mechanisms, functions, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Prerequisite: permission of instructor. (Also listed as Physiology 212.) 6 units. *Gutknecht, Schoffeniels, Wachtel, and Staff*

214. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology. Some work at sea aboard the research vessel. Prerequisites: a course in invertebrate zoology, ecology, marine biology or an appropriate equivalent; chemistry through organic, one year of physics and mathematics. (Given at Beaufort.) (Also listed as Zoology 214.) 6 units. *Barber*

240. Chemical Oceanography. Physicochemical properties of seawater. Lectures, laboratory work, and field trips. Prerequisites: a year of analytical or physical chemistry, an introductory course in general or physical oceanography or permission of the instructor. (Also listed as Chemistry 240 and Zoology 240.) (Given at Beaufort.) 6 units. *Baier*

250. Physiological Ecology of Marine Animals. A study of the physiological responses of marine animals in relation to certain environmental factors and evolution. Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology. (Given at Beaufort.) (Also listed as Zoology 250.) 6 units. *Forward*

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips will be made to study, collect, and classify animals in their natural habitats. Prerequisite: introductory college biology. (Given at Beaufort.) (Also listed as Zoology 274.) 6 units. *Staff*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. (Given at Beaufort.) (Also listed as Biochemistry 276 and Zoology 276.) 6 units. *Staff*

S277. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. *Hagadorn* (*University of North Carolina*)

S278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) 6 units. *Bookhout*

Mathematics

Professor Shoenfield, *Chairman* (135C Physics Building); Associate Professor Burdick, *Director of Graduate Studies* (135D Physics Building); Professors Carlitz, Dressel, Murray, Warner, Weisfeld, and Woodbury; Associate Professors Hodel, Kitchen, Moore, Scoville, Smith, and Stackelberg; Assistant Professors Henson, Kraines, Lees, MacKichan, O'Fallon, Wilkinson, and Wong

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis project involving the use of the computer.

All A.M. and Ph.D. candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will noramlly take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded course work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. candidate should satisfy the language requirement in one of these languages as early as possible. The department urges students to attain a reading knowledge of at least two of these languages. Members of the faculty remain free to assign readings in them for course work or dissertation work.

For Seniors and Graduates

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry; an algebraic model of Euclidean geometry. 3 units. *Staff*

206. Introduction of Stochastic Processes. Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. 3 units. *Wilkinson*

207, 208. Introduction to Algebraic Structures. Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants finite dimensional inner product spaces. Prerequisite: Mathematics 68 or 73 for 207; and 207 for 208. 3 units per semester. *Staff*

217, 218. Intermediate Analysis. The real and complex number systems, sequences and series, continuity, differentiation, integration. Prerequisite: Mathematics 74 for 217; and 217 for 218. 3 units per semester. *Staff*

221, 222. Numerical Analysis. See course description for Computer Science 221, 222. (Also listed as Computer Science 221, 222.) 3 units per semester. *Gallie*

223. Numerical Analysis III. See course description for Computer Science 223. (Also listed as Computer Science 223.) 3 units. *Patrick*

***227, 228. Theory of Numbers.** Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisite: calculus. 3 units per semester. *Carlitz*

***229, 230. Algebraic Numbers.** Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisite: theory of equations. 3 units per semester. *Carlitz*

***234. Sample Designs.** Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multi-stage sampling; methods of estimation; questionnaire construction refusals and not-at-homes. Prerequisite: Mathematics 183. 3 units. *Staff*

* Offered on demand.

235, 236. Algebra. Elementary categorical algebra; groups with operators, G-sets, structure of groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisite: Mathematics 208 or equivalent for 235; and 235 for 236. 3 units per semester. *Staff*

244. Analysis of Variance. Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe. Tukey, etc.). factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. 3 units. *Staff*

***245, 246. Combinatorial Analysis.** Generating functions, permutations, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. 3 units per semester. *Carlitz*

***247, 248. Arithmetic of Polynomials.** Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. *Carlitz*

260. Design of Experiments. Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. 3 units. *Burdick*

***262. Non-Parametric Statistics.** A study of statistical tests in which no assumption about the underlying distribution is made: one sample, two sample, k sample tests for nomial, ordinal and internal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 244 or consent of the instructor. 3 units. *Staff*

265, 266. Homological Algebra and its Applications. Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: 236 and 271, or consent of instructor. 3 units per semester. *Weisfeld*

271, 272. Introductory Topology. Basic set theory; topological spaces; separation axioms; metric spaces; continuity; connectedness; paracompactness. Prerequisite: calculus. 3 units per semester. *Staff*

***273, 274. Algebraic Topology.** Homology and cohomology theories; complexes; introduction to homotopy groups; Čech homology theory. Prerequisite: Mathematics 271-272. 3 units per semester. *Kraines*

***275, 276. Probability.** Foundations of probability. Random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 135 or calculus, and consent of the instructor. 3 units per semester. *Stackelberg*

284. Least-Squares Analysis of Linear Models. General linear models; geometrical interpretations; multiple regressions; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to non-linear models. Prerequisite: Mathematics 136. 3 units. *Burdick*

* Offered on demand.

285. Applied Mathematical Methods I. Vectors, line and surface integrals, tensors, complex variables, differential and integral equations. Prerequisite: Mathematics 74. 3 units. *Dressel and Wong*

286. Applied Mathematical Methods II. Wave equation, Fourier series, heat equation, telegraphic equations. Legendre polynomials, Bessel functions, Schrödinger's equation. Prerequisite: Mathematics 74. 3 units. *Dressel and Wong*

***287, 288. Foundations of Mathematics.** Propositional calculus, predicate calculus, axiomatized number theory. Godel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103, or consent of the instructor. (Also listed as Philosophy 287, 288.) 3 units per semester. *Henson*

290. Stochastic Processes. Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. 3 units. *Wilkinson*

291, 292. Analysis I, II. Theory of analytic functions, measure and integration theory, introduction to functional analysis. Prerequisite: Mathematics 218 or 140, or consent of the instructor. 3 units per semester. *Scoville*

293. Multivariate Statistics. Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's T^2 statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284, or consent of the instructor. 3 units. *O'Fallon*

***295. Mathematical Foundations of Statistical Inference.** Inference-theoretic approach to hypothesis testing, decision-making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful test; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. 3 units. *Staff*

297, 298. Axiomatic Set Theory. Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of the instructor. 3 units per semester. *Shoenfield*

For Graduates

***303, 304. Advanced Theory of Numbers.** Cubic and quartic reciprocity, partitions and diophantine analysis, sums of squares. Prerequisite: Mathematics 288, or consent of instructor. 3 units per semester. *Carlitz*

325, 326. Analysis III, IV. Advanced topics in complex and real analysis, measure and integration theory, functional analysis. Prerequisite: Mathematics 292 for 325; and 325 for 326. 3 units per semester. *Scoville*

***327, 328. Partial Differential Equations.** Boundary and initial value problems, regularity and existence theorems by methods of *a priori* estimates and functional analysis. Representations of solutions, spectral theory, and potential

* Offered on demand.

theory. Prerequisite: Mathematics 291-292, or consent of the instructor. 3 units per semester. *Staff*

***329, 330. Theory of Distributions.** Test functions, distributions, topological vector spaces, applications to the operational calculus, partial differential equations, and mathematical physics. 3 units per semester. *Staff*

***331, 332. Advanced Topics in Complex Variables.** Entire and meromorphic functions; harmonic functions and potential theory; Riemann surfaces; several complex variables. 3 units per semester. *Staff*

***333, 334. Analytic Theory of Numbers.** Distribution of primes, primes in an arithmetic progression, Waring and Goldbach problems, applications of elliptic functions. Prerequisite: Mathematics 291-292. 3 units per semester. *Carlitz*

***335, 336. Topics in Algebra.** Advanced topics in algebra to be selected from areas of current research. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. *Smith*

***343, 344. Differential Equations.** Manifolds, sheaves, differential operators and their prolongations. Spencer sequences, δ-cohomology, existence theorems for analytic partial differential equations, the δ-estimate, D-Neumann problem. Prerequisites: Mathematics 236, 272, and 292, or consent of the instructor. 3 units per semester. *Weisfeld*

***353, 354. Topics in Analysis.** Advanced topics in real and complex analysis to be selected from areas of current research. Prerequisite: Mathematics 325, which may be taken concurrently. 3 units per semester. *MacKichan*

361, 362. Hilbert Space. Spectral theory for Hermitian and unitary transformations; maximal symmetric transformations; canonical resolution of closed transformations; singular integral equations; the Weyl circle; indices for differential operators; deficiency characteristics of closed transformations; topologies for bounded transformations; von Neumann algebras; resolution theory; Abelian and factor rings. Prerequisites: Mathematics 236 and 292, or consent of instructor. 3 units per semester. *Murray*

***371, 372. Dimension Theory.** Theory of covers in normal spaces; inductive and covering dimension of metric spaces and of normal spaces; dimension of Euclidean spaces; mapping in spheres and applications; metric dimension and other metric-dependent functions. Prerequisites: Mathematics 271-272. 3 units per semester. *Hodel*

***377, 378. Topics in Topology.** Advanced topics in topology to be selected from areas of current research. 3 units per semester. *Hodel*

***383, 384. Lie Groups and Algebras.** Differential manifolds; Lie groups; one-parameter subgroups; Lie algebras; differential forms; classification and representations of compact Lie groups and semisimple Lie algebras; solvable and nilpotent algebras; Ado's theorem. Prerequisites; Mathematics 236, 271, and either Mathematics 218 or 291. 3 units per semester. *Shoenfield*

* Offered on demand.

***392. Nuclear Spaces.** The theory of nuclear locally convex spaces, as developed by Grothendieck and Pietsch; applications to spaces of distributions. Prerequisite: Mathematics 292. 3 units. *Moore*

***393. Topological Groups.** Elementary theory; Haar measure; compact groups; locally compact Abelian groups; duality theory. Prerequisites: Mathematics 236 and 272, or consent of instructor. 3 units. *Warner*

***394. Topological Rings.** Compact, locally compact, and linearly compact rings. Prerequisite: Mathematics 393, or consent of instructor. 3 units. *Warner*

***395, 396. Topological Algebra.** Normed and locally convex spaces, Banach algebras. Prerequisites: Mathematics 236 and 292, or consent of the instructor. 3 units per semester. *Moore*

***397, 398. Seminar in Algebra and Number Theory.** Prerequisite: consent of the instructor. 3 units per semester. *Carlitz*

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. For a description of the program see p. 25; for a description of individual courses see listings under the specified department.

DEPARTMENT OF ART

233. Early Medieval Architecture. *Sunderland*

234. Romanesque Sculpture. *Sunderland*

237. French Renaissance Art. *Jenkins*

238. Sienese Painting. *Jenkins*

248. Florentine Painting during the Renaissance. *Covi*

251-252. Research. *Heckscher*

253. Studies in Italian Renaissance Sculpture. *Covi*

255, 256. Iconological Problems. *Langedijk*

DEPARTMENT OF CLASSICAL STUDIES

Latin

221. Medieval Latin I. *Newton*

222. Medieval Latin II. *Newton*

312. Proseminar in Latin Palaeography. *Newton*

Seminar in Textual Criticism. *Newton*

Classical Studies

Seminar in Byzantine History. *Rigsby*

* Offered on demand.

DEPARTMENT OF ENGLISH

207, 208. **History of the English Language.** *Nygard and Reiss*

210. **Old English Literary Tradition.** *Nygard and Reiss*

212. **Middle English Literary Tradition.** *Nygard and Reiss*

215, 216. **Chaucer.** *Nygard and Reiss*

221. **English Prose of the Sixteenth Century.** *Lievsay*

222. **English Non-Dramatic Poetry of the Sixteenth Century.** *Lievsa*

223. **Spenser.** *Lievsay*

224. **Shakespeare.** *Williams*

225, 226. **Tudor and Stuart Drama, 1500-1642.** *Randall*

229. **English Literature of the Seventeenth Century.** *Lievsay and Randall*

232. **Milton.** *Lievsay*

310. **Beowulf.** *Nygard*

312. **Studies in Middle English Literature.** *Nygard and Reiss*

315. **Studies in Chaucer.** *Nygard and Reiss*

318. **Medieval Romances.** *Reiss*

320. **Studies in Renaissance English Prose.** *Lievsay*

324. **Studies in Shakespeare.** *Williams*

329. **Studies in the Metaphysical Poets.** *Lievsay and Williams*

383. **Textual Criticism.** *Williams*

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. **Middle High German.** *Stern*

215. **Seventeenth-Century Literature.** *Borchardt*

216. **History of the German Language.** *Stern*

217. **Renaissance and Reformation Literature.** *Borchardt*

DEPARTMENT OF HISTORY

221-222. **Problems in the History of Late Medieval and Early Modern Europe.** *Witt*

237-238. **Europe in the Middle Ages, 395-1500.** *Young*

267-268. **From Medieval to Early Modern England.** *Ferguson*

305-306. **Seminar in British History.** *Ferguson*

337-338. **Seminar in Medieval History.** *Young*

351.10-352.10. Medieval Europe. *Young*

351.15-352.15. The English Renaissance. *Ferguson*

DEPARTMENT OF PHILOSOPHY

218. Medieval Philosophy. *Mahoney*

DEPARTMENT OF RELIGION

236. Luther and the Reformation in Germany. *Steinmetz*

241. Problems in Reformation Theology. *Steinmetz*

251. The Counter-Reformation and the Development of Catholic Dogma. *Steinmetz*

331. The Social Message of the Early and Medieval Church.

332. The Medieval Church.

334. Church Reformers and Christian Unity.

336. Christian Mysticism in the Middle Ages.

338. Calvin and the Reformation in Switzerland. *Steinmetz*

339. The Radical Reformation. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. *Steinmetz*

DEPARTMENT OF ROMANCE LANGUAGES

French

213, 214. French Literature of the Seventeenth Century. *Auld*

219. Old French Literature. *Vincent*

224. History of the French Language. *Hull*

225, 226. From Renaissance to Baroque in French Literature to the Sixteenth Century. *Tetel*

Italian

284. Dante. *Fowlie*

288. The Renaissance. *Tetel*

Spanish

251. The Origins of the Spanish Novel. *Wardropper*

252. Spanish Lyric Poetry Before 1700. *Wardropper*

253. The Origins of the Spanish Theater. *Wardropper*

257. Old Spanish. *Davis*

258. Old Spanish Literature. *Davis*

265. Golden Age Literature: Cervantes. *Predmore and Wardropper*

266. Golden Age Literature: The Drama. *Wardropper*

Microbiology and Immunology

Professor Joklik, *Chairman* (Research Park IV); Professor Willett, *Director of Graduate Studies* (111 Research Park IV); Professors Amos, Beard, Burns, Conant, Day, Metzgar, and Osterhout; Associate Professors C. Buckley, III, R. Buckley, Rosse, Seigler, and Wheat; Assistant Professors Bolognesi, Lauf, Luftig, Nichols, Scott, Smith, Vanaman, Ward, and Zweerink

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

215. Bacteriophage: Structure and Function. Classical experiments of Luria, Hershey, and Delbrück. Timing of events during infection. Morphogenesis of component substructures and their subsequent assembly into mature virions. Analysis of electron micrographs. Interactions of bacteriophage with host-cell walls and membranes. These areas will be covered in the context of coliphages. (Also listed under the University Program in Genetics.) Fall. 2 units. *Luftig and Nichols*

219. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Pathology 219, and Physiology 230.) 3 units. *McCarty and Staff*

219S. Seminar. Optional seminar offered in conjunction with Microbiology 219.

221. Medical Microbiology. An intensive study of the common bacteria, viruses, fungi, and parasites which cause disease in man. The didactic portion of the course focuses on the nature and biological properties of microorganisms causing disease, the manner of their multiplication, and their interaction with the entire host as well as specific organs and cells. 4 units. *Joklik and Staff*

233. Microbiology. A course designed to provide students with a basic understanding of the microbial world. Special emphasis will be given to structure, composition, growth, and metabolism of bacterial cells. 3 units. *Joklik, Burns, Conant, and Willett*

252. General Animal Virology and Viral Oncology. The first half of the course will be devoted to a discussion of the structure and replication of mammalian viruses with special emphasis on the molecular and functional aspects. A second part of the course will deal specifically with tumor viruses, which will be discussed in terms of the virus-cell interaction and the response to the host. The relationship of virus infection to neoplasia will be emphasized. 4 units. *Joklik, Smith, and Zweerink*

282. Molecular Microbiology. A study of the structure, growth, and replication of bacteria with a detailed analysis of the synthesis and regulation of the structural, informational, and catalytic macromolecules. Major topics covered include: structure, function, and synthesis of bacterial integuments, DNA, RNA, and protein; genetic and metabolic regulatory mechanisms; primitive differentiation in procaryotes. Prerequisite: general biochemistry. 4 units. *Burns, Nichols, Vanaman, Wheat, and Willett*

291. Immunology I. Structure and function of immunoglobulins. Characteristics of synthetic and natural antigens. Cellular aspects and kinetics of antibody ormation. Forms of immunologic responsiveness. Elicitation and control of immune response. Phylogeny and ontogeny of immunity. Specificity and cross-reactivity. Methods of immunologic analysis. Tolerance, enhancement, autoimmunity, and allergy. 4 units. *Scott and Staff*

292. Immunology II. Continuation of Immunology I. 4 units. *Amos and Staff*

For Graduates

311. Immunochemistry. The primary and conformational structures of he immunoglobulins—chains, regions, sizes, allotypes, evolution. The antibody binding site—location, specificity, subgroups, idiotypes, antigen accommodation. The reaction of antibodies—affinity and the law of mass action, homogeneous binding, kinetics, virus model, precipitation reactions, active centers of multivalent antigens, conformational determinants. Affinity, the immune responses, and clonal selection. 3 units. *Day*

313. Immunohematology. A lecture course covering historical and current concepts of blood cell antigens and antibody. Emphasis will be placed on the genetics, serology, chemistry, and anthropological aspects of human red cell soantigens and antibodies. White cell and platelet antigens, the hematological consequences of immunological reactions involving the cellular elements of the blood, and comparative blood group antigens in other species will also be considered. 2 units. *Rosse*

323. Readings in Bacteriology and Immunology. A course of readings and syntheses in restricted areas of bacteriology and immunology, under the direction of individual staff members. 2 units.

325. Medical Mycology. This course is intended to familiarize the graduate student majoring in mycology with the fungi causing disease in man and animal. The course includes practical laboratory work with materials from patients in Duke Hospital and those sent to the Duke Fungus Registry from outside sources. Prerequisites: a master's degree in botany with major in mycology and Microbiology 221. Maximum registration: four students. 4 units. *Conant*

331.1-331.8. Microbiology Seminar. Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all first-year students in microbiology and immunology, and for all advanced students specializing in microbiology. 1 unit per semester. *Staff*

332.1-332.8. Immunology Seminar. Current topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all first-year students in microbiology and immunology, and for all advanced students specializing in immunology. 1 unit per semester. *Staff*

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction and chemistry. Phylogeny of iso-antigenic systems of man and animals.

Tests for histocompatibility including lymphocyte interactions and reactivity Change in antigenicity and immune responsiveness in carcinogenesis. Immunologi factors in pregnancy and in homotransplantation of organs. (Also listed under th University Program in Genetics.) 2 units. *Amos and Ward*

420. Cellular Immunophysiology. See course description for Physiolog 420. (Also listed as Physiology 420.) 2 units. *Lauf and Staff*

Pathology

Professor Kinney, *Chairman* (301B Medical School); Professor Sommer, *Directo of Graduate Studies* (301 Medical School); Professors Fetter, Hackel, Johnston Vogel, Pratt, and Wittels; Associate Professors Elchlepp, Bradford, Klintworth Ratliff; Assistant Professors Adams, Bigner, Bossen, Daniels, Dorsey, Jauregui Sage, Spooner, Tisher, and Wilson

The Department of Pathology offers graduate work leading to the Ph.D degree with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of biophysical, biomathematical, and biochemical approaches. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of speciality and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

219. Molecular and Cellular Basis of Development. For a description o the course see Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219 Microbiology 219, Pathology 219, and Physiology 230.) 3 units. *Counce, McCarty, and Staff*

219S. Seminar. Optional seminar offered in conjunction with Pathology 219.

250. General Pathology. The fundamentals of pathology are presented to the student. Lectures developing broad concepts of disease processes are given by the members of the senior staff. The emphasis is placed on etiology and pathogenesis of disease. Lecture. Prerequisites: histology and permission of instructor. 4 units *Kinney and Staff*

251. Laboratory Course in General Pathology. Laboratory session to complement 250. Gross and microscopic material is correlated with, and related to, disease processes. Pathology 250 may be taken concurrently. Prerequisite: histology and permission of instructor. 4 units. *Kinney and Staff*

325. Cardiovascular Pathology. Cardiovascular disease processes will be studied, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross and microscopic specimens. Consideration will be given to principles of electrocardiography. (Fall only.) 3 units. *Hackel and Ratliff*

352. Basic Problems in Chemical Pathology. This is an advanced seminai tutorial course in which the biochemical and physiological expressions of morphologic abnormalities will be explored. Specific organ systems will be used as a model for instruction and discussion. Experimental approaches toward soluons of problems will be discussed. Prerequisite: permission of instructor. 2 units. *Vittels*

353. Advanced Neuropathology. This course deals with current problems nd research methods related to diseases which affect the nervous system. Preequisite: permission of instructor. (Fall only.) 2 units. *Vogel*

355, 356. Graduate Seminar in Pathology. Discussions outlining the scope f modern pathology. This will include reports of original researches by members f staff and visitors. Time to be arranged. 1 unit each semester. *Sommer and taff*

357. Research in Pathology. Independent research projects in various fields f pathology. Time and credit to be arranged. *Kinney and Staff*

358. Cellular and Subcellular Pathology. This course is designed for stuents wishing to broaden their knowledge of cellular structure and cellular patholgy. The course consists of lectures and seminars discussing the alterations in ellular structure and associated functions that accompany cell injury. Prerequisite: ermission of instructor. *Sommer*

360. Histochemistry. Theory and application of histochemical techniques or investigating the presence of proteins, lipids, carbohydrates, and enzymes t the light and/or electron microscopic level. A quantitative identification of ucleoproteins by cytophotometric and autoradiographic techniques will be given pecial consideration. Students will be encouraged to develop a small project f their choice. Fall and spring. 3 units. *Jauregui and Staff*

361, 362. Autopsy Pathology. A detailed consideration of the morphogic, physiologic, and biochemical manifestations of disease. Emphasis is on ndividual work in the laboratory with tutorial supervision. Gross dissection, histoogic examination, processing, and analyzing of morphologic, microbiologic, and iochemical data, and interpretation of results. Prerequisites: Pathology 350 and ermission of instructor. 3 units per semester. *Kinney and Staff*

364. Systemic Pathology. Systematic presentation of the characteristics f disease processes as they affect specific organ systems in mammals. 6 units. *ackel and Staff*

367, 368. Special Topics in Pathology. Special problems in pathology will e studied with a member of the senior staff; the subject matter will be individually rranged. Time to be arranged. 4 units. *Kinney and Staff*

369. Ophthalmic Pathology. This course will consist of lectures, seminars, nd laboratory sessions. The normal anatomy and embryology of the eye will e reviewed as a basis for the study of the various ocular disease processes. The ore common diseases of the eye will be considered in detail. Problems in ophthalic pathology will be discussed together with methods of solving them. (Fall only.) units. *Klintworth*

370. Developmental Pathology and Teratology. A systematic study of disase processes involving the prenatal, natal, and postnatal period. Emphasis will e placed on developmental anatomy and teratogenesis. The format includes eminars and clinicopathologic correlations derived from gross and microscopic aterial. Prerequisites: Pathology 350, anatomy, and histology. (Fall only.) 3 nits. *Bradford and Wilson*

373. Cytopathology. This course is designed to present the principles an techniques by which basic cytology is applied to the diagnostic interpretation o disease. Classroom and laboratory work will include diseases involving the femal genital tract, respiratory tract, urinary tract, effusions, gastrointestinal tract, an central nervous system. Neoplastic disease will be emphasized. Practical application of the acquired knowledge will be made in examining current material Prerequisites: Pathology 350, 351, or permission of instructor. (Fall.) 3 units *Johnston and Staff*

374. Pulmonary Pathology and Postmortem Pathophysiology. Emphasi will be on pulmonary pathology and pathophysiology of infectious, metabolic environmental, and neoplastic diseases, and certain diseases of unknown etiolog (e.g., sarcoid, alveolar proteinosis, etc.). Ventilatory experiments will be don on excised human lungs. Fall. 3 units. *Pratt*

375. Fundamentals of Electron Microscopy. The course will consist o one lecture and one seminar per week, covering the theoretical basis of practica electron microscopy. Areas to be discussed include the nature of light and electrons, light and electron optics, image recording and processing by photographi and other methods, specimen preparation, functional anatomy of the electro microscope, and several special techniques. Student presentations and selection o special topics will be encouraged. The approach will be non-mathematical bu college physics is strongly recommended. Fall and spring. 2 units. *Sommer and Sta*

377. Pathology of the Kidney. The course includes a comprehensive stud of pathological, immunological, and clinical features of the glomerulonephritides the nephrotic syndrome, and pyelonephritis, as well as of metabolic, congenital and neoplastic renal disorders. Lectures will be supplemented with gross an microscopic specimens, demonstrations, and special library studies. Fall. 3 units *Tisher*

378. Immunopathology. A study of human diseases in which the immun system plays an important role. A series of lectures, seminars, and studies o human case materials. Fall. 4 units. *Daniels, Bigner, Adams, and Bossen*

379. Pathology of Virus Infections. The pathological effects of viruse will be discussed. A series of lectures and student-conducted seminars concernin the structural, biochemical, and functional alterations associated with virus-cel interactions. Spring. 4 units. *Daniels and Bigner*

Philosophy

Professor Welsh, *Chairman* (201K West Duke Building); Associate Professo Sanford, *Acting Director of Graduate Studies* (201D West Duke Building); Professors Negley and Peach; Associate Professors Mahoney and Roberts; Assistan Professors Aquila, Benditt, and Coder; Visiting Associate Professor Evans

The Department of Philosophy offers graduate work leading to the A.M and Ph.D. degrees. Tutorial work complements formal instruction. Student may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophical analysis, ethics, aesthetics, political philosophy, and philosophy of law.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take two or three qualifying examinations, diagnostic in purpose. One examination is in the history of philosophy, ancient and modern; a second examines his ability to deal critically and systematically with some basic philosophical topic; a third examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School or the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, s required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

For Seniors and Graduates

202. Aesthetics: The Philosophy of Art. A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music, and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, and evaluation in literature, meaning in the arts, art and truth, the arts and morality. 3 units. *Welsh*

203. Contemporary Ethical Theories. Study of the nature and justification of basic ethical concepts and principles in the light of the chief ethical theories of twentieth-century British and American philosophers. 3 units. *Benditt*

204. Philosophy of Law. Natural law theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. 3 units. *Benditt*

205. Philosophy of History. Discussion of the method, metaphysical implications, and influence of interpretations of history: Hegel, Marx, Spengler, Toynbee. 3 units. *Negley*

208. Political Values. Analysis of the systematic justification of political principles and the status of political values in the administration of law. 3 units. *Negley*

211. Plato. A critical study of selected dialogues with special emphasis on problems in epistemology and metaphysics. 3 units. *Mahoney*

217. Aristotle. A study of passages from the *Organon, Physics, De Anima,* and *Metaphysics*. 3 units. *Mahoney and Evans*

218. Medieval Philosophy. A critical examination of selected problems i medieval philosophy. 3 units. *Mahoney*

***219. Kant's Moral Philosophy.** 3 units. *Negley*

225. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume, with special emphasis on problems in the theory of knowledge 3 units. *Peach*

227. Continental Rationalism. A critical study of the writings of Descartes Spinoza, or Leibniz, with special emphasis on problems in the theory of knowledg and metaphysics. 3 units. *Peach and Roberts*

228. Recent and Contemporary Philosophy. A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore Russell, Wittgenstein, Wisdom, and Ryle. 3 units. *Welsh*

***229. American Pragmatism.** Studies in the philosophy of Peirce, James Dewey, and Mead. 3 units. *Welsh*

230. The Meaning of Religious Language. See course description for Religion 230. (Also listed as Religion 230.) 3 units. *Poteat*

231. Classical German Philosophy. Selected topics in eighteenth and nineteenth century German philosophy. 3 units. *Aquila*

232. Recent Continental Philosophy. Selected topics. 3 units. *Aquil*

233. Methodology of the Empirical Sciences. An introduction to recen philosophical discussion of a variety of problems, e.g., the concept of a scientifi explanation, the nature of laws, theory and observation, and other topics. Approva of the instructor is required for undergraduates and for students from departments other than Philosophy. 3 units. *Roberts*

234. Problems in the Philosophy of Science. Selected problems in the physical and non-physical sciences, e.g., space and time, measurement, probability and induction, the philosophy of the behavioral and social sciences. Approva of the instructor is required for undergraduates and for students from departments other than Philosophy. 3 units. *Roberts*

241. Symbolic Logic. Detailed analysis of deduction and of deductive systems. 3 units. *Coder*

251. Epistemology. Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. 3 units. *Sanford*

252. Metaphysics. Selected topics in metaphysics, e.g., substance, qualities and universals, identity, space, time, causation, and determinism. 3 units *Sanford*

253. Philosophy of Mind. An analysis of mental concepts such as thought belief; and such issues as mind-body relations, thought and action; the nature o persons and personal identity. 3 units. *Aquila and Coder*

260. Wittgenstein. An examination of the *Tractatus* or the *Investigations* 3 units. *Welsh*

* Offered on demand.

287, 288. Foundations of Mathematics. See course description for Mathematics 287, 288. (Also listed as Mathematics 287, 288.) 3 units per semester. *Henson*

291, 292. Seminar in Special Fields of Philosophy. *Staff*

For Graduates

331, 332. Seminar in Special Fields of Philosophy. 3 units. *Graduate Staff*

Physical Therapy

Assistant Professor Mathews, *Acting Chairman and Director of Graduate Studies* 045 Hospital); Associate Professor Branch; Assistant Professor Villanueva

The Department of Physical Therapy offers a graduate program leading to he M.S. degree. Before undertaking graduate work in physical therapy a student should have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and mathematics. As part of the prescribed curriculum of the first year students are required to take Anatomy 300 and Physiology 200. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3247, Duke University Medical Center.

201, 202. Seminar in Physical Therapy. Historical background and trends n the profession; orientation to physical therapy departmental organization and administration; professional and community relationships; professional ethics; methods of communication; and literature review. Units by arrangement. *Mathews and Staff*

217. Physical Therapy Dynamics I. Orientation to patient care; principles of biomechanics; developmental patterns of movement and posture; theory and practice of selected therapeutic methods. 3 to 4 units. *Branch, Mathews, Villanueva, and Staff*

218. Physical Therapy Dynamics II. Regional approach to functional anatomy; principles and practice of physical therapy; biophysical and physiological considerations for utilization of selected therapeutic agents (mechanical, thermal, chemical, and electrical), with emphasis on methods of neuromuscular re-education. 5 units. *Villanueva and Staff*

220. Physical Therapy Dynamics III. Principles and practice of physical therapy; principles of prevention of deformity and disability; methods of facilitation of functional capacity; use of orthotic and prosthetic devices; synthesis of theory and practice in planning effective treatment programs. 2 to 4 units. *Villanueva and Staff*

230. Physical Evaluation and Instrumentation. Principles and techniques of objective assessment and analysis of functional status as performed by the physical therapist including manual muscle tests, goniometry, electrical diagnostic testing, posture analysis, body measurements, evaluation of respiratory and sensory function, checkouts for prosthetic devices, disability evaluation, prevocational testing, and orientation to electromyography and dynamometry. 3 units. *Staff*

234. Introductory Pathology. Fundamentals of pathology, with emphasi on broad concepts of disease processes; systems of the body are studied from th point of view of histological and functional change. 3 units. *Branch and Speci Lecturers*

236. Medical Sciences. Lectures by clinicians with patient demonstratio and correlation of treatment methods; medical and surgical, neurological, orth paedic, and emotional conditions affecting human dysfunction; emphasis on psych dynamic principles of patient-therapist relationships. 4 units. *Staff and Speci Lecturers*

***238. Introduction to Health Service Systems.** Political, economic, an sociocultural aspects of the organization of health care systems; structural com ponents and interrelationships; criteria for assessing and analyzing health ca systems. 2 to 3 units. *Mathews*

242. Directed Clinical Experience in Physical Therapy I. Students a assigned to hospitals, rehabilitation centers, schools for crippled children, extende care facilities, and public health units for short-term supervised learning exper ences. 1 to 2 units. *Staff*

243. Directed Clinical Experience in Physical Therapy II. Students a assigned to full-time learning experiences under direction. 2 to 4 units. *Staff*

301. Introduction to Scientific Inquiry. Theory and use of analytical met ods of problem-solving; elements of scientific writing; preparation of a researc protocol and a major paper. 3 units. *Mathews*

***315. Curriculum Development.** Introduction to learning theory; develo ment of objectives, organization, course content and evaluation in physical therap education. 2 to 3 units. *Staff*

316. Directed Teaching in Physical Therapy. 1 to 3 units. *Staff*

***320. Sensorimotor Mechanisms Related to Rehabilitation.** Developme of normal motor behavior, and structural and functional organization of the nervo system related to methods of facilitating functional capacities for performing th activities of daily living. 2 to 3 units. *Villanueva and Staff*

***322. Case Conferences in Rehabilitation.** Observation and demonstratio of care of patients with extensive disability; emphasis on integration of health se vices for comprehensive care via the case conference approach. 1 to 2 units. *Sta*

332. Administration of Physical Therapy Services. Principles of admini tration, leadership styles, and management roles; concepts of systems theory a analysis; planning, organizing, delivering, and evaluating physical therapy syste and subsystems. 3 units. *Mathews*

341-342. Advanced Seminar—Selected Problems. 2 to 3 units. *Sta*

350. Research. Units by arrangement. *Staff*

Physics

Professor Fairbank, *Chairman* (119 Physics Building); Associate Professor Evan *Director of Graduate Studies* (111 Physics Building); Professors Biedenha ilpuch, Gordy, Greuling, Lewis, Meyer, Newson, Robinson, and Walker; Adjunct rofessors Robl and Way; Associate Professors Cusson, Fortney, Han, Roberson, nd Walter; Assistant Professors DeLucia, Loos, Riedel, Rose, and Sykes

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* Offered on demand.

The Department of Physics offers graduate work for students wishing to earn e A.M. or Ph.D. degree. In addition to a balanced program of basic graduate ourses, the department offers specialized courses and seminars in several fields, which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to t his needs, including work in a related field, usually mathematics or chemistry. tudents are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. egree only, and students making good progress are advised to work directly for e Ph.D. The option of taking the A.M. without thesis is available with the pproval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, r Russian, is required for the Ph.D. degree.

or Seniors and Graduates

***209. Introduction to Solid State Physics.** Description of basic physical rocesses in solids with emphasis on dielectrics, metals, and semiconductors. Introduction to crystal structure and thermal and magnetic properties. 3 units.

215. Introduction to Quantum Mechanics. Wave mechanics and elemenary applications; the hydrogen-like atoms; electron spin and angular momentum; perators and eigenvalues; stationary state perturbation theory; identical particles. rerequisites: Physics 162, 182 or equivalents; Mathematics 285-286 may be aken concurrently. 3 units. *Cusson*

217, 218. Advanced Physics Laboratory and Seminar. Measurements inolving the fields of mechanics, electricity, magnetism, heat, sound, optics, and nodern physics. 3 units per semester. *Meyer*

220. Advanced Electronics. Vacuum tubes and solid state devices, adanced circuit analysis. 3 units. *Roberson*

***221, 222. Theoretical Physics.** Mechanics of particles and of rigid bodies, lasticity, fluid dynamics, electrodynamics; optics, relativity, thermodynamics, tatistical mechanics, wave mechanics. Prerequisite: Mathematics 285-286, or quivalent, which may be taken concurrently. 3 units per semester.

223, 224. Electricity and Magnetism. Electrostatics, magnetostatics, and otential theory; dielectric and magnetic media; magnetic field of currents and the aw of induction. Maxwell's electrodynamics. 3 units per semester. *Loos*

or Graduates

302. Advanced Mechanics. The fundamental principles of Newtonian mechanics; general dynamics of systems of particles and rigid bodies; the methods of agrange and Hamilton; generalized mechanics. 3 units. *Fortney*

303. Statistical Mechanics. Fundamental laws of thermodynamics and tatistical mechanics with applications to physics and chemistry. Classical and

* Offered on demand.

quantum ideal gases; approximate methods for real gases and liquids. Prerequisite Physics 215. 3 units. *Sykes*

***304. Advanced Topics in Statistical Mechanics.** This course will var from year to year. Possible topics include Fermi liquids, systems of bosons, many body theory, non-equilibrium statistical mechanics. Prerequisites: Physics 303 an 316. 3 units. *Sykes*

305. Introduction to Nuclear Physics. Phenomenological aspects of nuclear physics; interaction of gamma radiation and charged particles with matter nuclear detectors; particle accelerators; radioactivity; basic properties of nuclei nuclear systematics; nuclear reactions, particle scattering; nuclear models of the deuteron; nuclear forces; parity. 3 units. *Roberson*

***306. Low Temperature Physics.** The properties of matter near the absolut zero of temperature; superconductivity, liquid helium, adiabatic demagnetization Prerequisite: Physics 303. 3 units. *Fairbank*

308. Introduction to High Energy Physics. High energy processes; electromagnetic, weak, and strong interactions. 3 units. *Walker*

309. Solid State Physics I. Properties of matter in the condensed state crystal lattices, electrons in metals and semiconductors, band theory, non-metalli solids, lattice dynamics, and phonons. Prerequisites: Physics 215 and 303. 3 units *Riedel*

***310. Solid State Physics II.** Elementary excitations and their interaction in the condensed state of matter; scattering theory and correlation functions; magnetic interactions in solids, superconductivity; amorphous solids. Prerequisites Physics 309 and 316. 3 units. *Riedel*

312. Phase Transitions and Critical Phenomena. Description of phas transitions in diverse physical systems such as fluids, magnets, mixtures, and superfluids. Experimental techniques and results. Application of the classical method of thermodynamics, correlation functions, and mean field theory to the critica state of matter. Microscopic models of phase transitions. Modern approaches t static and dynamic critical phenomena such as the theories of critical exponents scaling, series expansions, critical relaxation, and mode-mode coupling. 3 units *Riedel*

316. Principles of Quantum Theory. Original and fundamental concept of quantum theory; wave and matrix mechanics; theory of measurements; exclusion principle and electronic spin. Prerequisite: Physics 302. 3 units. *Biedenharn*

317. Intermediate Quantum Theory. General operator methods; angula momentum; Dirac electron theory. Second quantization; symmetry principles an conservation theorems. Applications to the theory of solids, of nuclei, and o elementary particles will be stressed. Prerequisite: Physics 316. 3 units. *Biedenharn*

318, 319. Electromagnetic Field Theory. Electrodynamics; theory of wave optics; radiation of electric and magnetic multipole fields; special relativity; covariant electrodynamics; Lienard-Wiechert potentials; scattering and dispersion

* Offered on demand.

Hamiltonian field equations. Prerequisite: Physics 223. 3 units per semester. *Greuling*

***330. Nuclear Structure Theory.** Two body nuclear forces used to describe nuclear structure; nuclear shell and collective models; properties of nuclear levels; magnetic and quadrupole moments; transition probabilities; nucleon-nucleon scattering; nuclear reactions. Prerequisites: Physics 305 and 316. 3 units.

***331. Microwave Radiation.** Microwave generators, cavity resonators, transmission lines, radiation propagation, and detection. 3 units. *Gordy*

***335. Microwave Spectroscopy.** Application of microwaves in the determination of molecular, atomic, and nuclear properties. Stark and Zeeman effects n microwave spectroscopy. Magnetic resonance absorption. 3 units. *Gordy*

***341. Advanced Topics in Quantum Theory.** Introduction to relativistic quantum field theory; Lorentz and Poincaré groups; quantization of free fields; nteracting fields and S-matrix; applications to quantum electrodynamics and dispersion relations. Prerequisite: Physics 317. 3 units. *Han*

***342. Theory of Elementary Particles.** Theoretical methods used in treating particle interactions, emphasizing phenomenological treatments. Quantum field theory and dispersion theory is developed as needed. Applications in the general areas of pion physics, electromagnetic interactions of hadrons, strange particle nteractions, and weak interactions are surveyed. Prerequisite: Physics 316. 3 units. *Han*

***343. Nuclear Physics.** Elementary theory of the deuteron; low energy neutron proton scattering; theory of nuclear reactions; penetration of potential barriers; nuclear energy levels. Prerequisite: Physics 215. 3 units. *Newson*

***344. Advanced Nuclear Physics.** The deuteron, nuclear forces, scattering of elementary particles, beta-radiation. Other aspects of nuclear physics susceptible of theoretical interpretation. 3 units. *Biedenharn*

***345. High Energy Physics.** Experimental and theoretical aspects of high energy nuclear processes; properties of mesons and hyperons. 3 units.

***346. Topics in Theoretical Physics.** The content of this course will vary from year to year. General methods in quantum mechanics such as group theory and its applications; elementary particle theory; field theory; theory of solids; theoretical nuclear physics; atomic and molecular structure. Prerequisites: Physics 316, 317. 3 units.

351, 352. Seminar. A series of weekly discussions on topics related to the research projects under investigation in the department. 2-4 units. *Graduate Staff*

397, 398. Low Temperature and Solid State Seminar. Weekly seminar on advanced topics and recent research work in the field of low temperature and solid state physics. 2-4 units. *Riedel and Sykes*

* Offered on demand.

Physiology and Pharmacology

Professor Tosteson, *Chairman* (388 Medical Sciences I); Associate Professo McManus, *Director of Graduate Studies* (354 Medical Sciences I); Professor Bernheim, Blum, Hitchings, Jöbsis, Johnson, Lack, Maxwell, Moore, Narahashi Nichol, Renkin, and Somjen; Associate Professors Fellows, Kylstra, Lauf, Menzel Ottolenghi, Padilla, Posner, Salzano, Schanberg, and Wolbarsht; Assistant Professors Anderson, Elford, Greenfield, Gunn, Gutknecht, Kirk, Lieberman, Mendell Mills, Schomberg, Schooler, Slotkin, and Wachtel

In the Department of Physiology and Pharmacology graduate work is offered leading to the Ph.D. degree. Before undertaking graduate work in physiology or pharmacology a student should have a strong background in basic sciences including course work in mathematics, chemistry, physics, and biology. Students are accepted for graduate work who have undergraduate majors in any of the following areas: biology, chemistry, physics or engineering. A brochure is available from the department which describes the program of study, financial assistance, facilities, and the research activities of the staff.

For Seniors and Graduates

200. Physiology of Man. An introduction to the basic concepts of physiology with particular reference to man. Three lectures, one laboratory, and two conferences per week. Fall term. 6 units. *Graduate Staff*

201. Pharmacology: Mode of Action of Drugs. Studies and discussion of the pharmacological action of drugs in terms of biochemical and physiologica processes. Three lectures and one conference per week. Prerequisite: Physiology 200 or equivalent. 4 units. *Graduate Staff*

207. Cardiovascular and Respiratory Physiology and Pharmacology I Selected topics in the physiology and pharmacology of cardiac muscle and the peripheral circulation, including general and comparative morphology and ultrastructure of cardiac muscle, some aspects of developmental physiology, cardiac electrophysiology and mechanics, and excitation-contraction coupling. Prerequisite: undergraduates—permission of instructor. 2 units. *Johnson and Staff*

208. Respiratory System in Health and Disease. Primary emphasis is on various aspects of the physiology of respiration. Topics covered include pulmonary mechanics, central and peripheral regulation of ventilation, pulmonary circulation, and respiratory responses to exescise, altitude, and hyperbaric environments 2 units. *Salzano, Kylstra, and Saltzman*

210, 211. Individual Study and Research. Directed reading and research in physiology and pharmacology. Prerequisites: senior standing and permission of the Director of Graduate Studies. 3 to 9 units per semester. *Staff*

212. Marine Membrane Physiology. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiological processes. The course includes lectures and laboratory work on the mechanisms and comparative aspects of ionic and osmotic regulation in marine plants and animals. (Given at Beaufort.) Prerequisite: permission of instructor. 6 units. *Gutknecht, Schoffeniels, Wachtel and Staff*

213. Cellular and Chemical Pharmacology. Chemical aspects of cell-drug nteraction and structure-activity relationships. Cholinergic mechanisms—pharmacological, and applied aspects. Biogenic amines—pharmacological and behavioral aspects. Psychoactive drugs and pharmacology of excitable tissues. (Alternate years beginning fall, 1974.) 3 units. *Ottolenghi and Staff*

215. Topics in Developmental Physiology and Pharmacology. An analysis of the physiological basis of development at the organ level with special reference to vertebrates. Topics will include development of neuronal connections, cardiogenesis, hormonal regulation, and pharmacological interactions in organogenesis. Prerequisite: permission of the instructor. 2 units. *Lieberman, Mendell and Padilla*

216. Contractile Processes in Physiology and Pharmacology. Cellular basis of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure of muscle, electrical and ionic properties of muscle membranes; the problem of electro-mechanical coupling; mechanics and thermodynamics of muscular contraction; biochemical energetics of contraction. Prerequisite: permission of instructor. (Alternate years beginning fall, 1974.) 3 units. *Anderson, Jobsis, and Johnson*

217. Membrane Transport Processes in Physiology and Pharmacology. Chemical composition and ultrastructure of biological membranes, ionic and osmotic equilibria across the membranes of individual cells, passive and active onic transport, the role of ATPase, carrier-mediated diffusion of non-electrolytes, ntegration of transport processes to produce molecular movements across organized epithelia (e.g., amphibian skin and bladder and gastrointestinal mucosa). Prerequisite: permission of instructor. 3 units. *Gunn, Gutknecht, Kirk, Lauf, McManus, and Tosteson*

218. Physiological Instrumentation. Electronic methods of measurement of physiological variables. The operational amplifier is used as the active building block in appropriate feedback circuits containing only passive elements to make a wide range of linear instruments including analog computers. Digital logic and computing elements are also developed. (Alternate years beginning spring, 1973.) Prerequisite: undergraduates—permission of instructor. 3 units. *Moore and Staff*

230. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, and Pathology 219.) *Padilla, Counce, McCarty, and Staff*

230S. Optional seminar offered in conjunction with Physiology 230.

279. Student Tutorial in Physiology and Pharmacology. An introduction to critical reading of selected papers in physiology or pharmacology. Required of all first-year graduate students. 2 units. *Graduate Staff*

280. Student Seminar in Physiology and Pharmacology. Readings and discussions in depth of several aspects of physiology and pharmacology. Required of all second-year graduate students. 2 units. *Graduate Staff*

For Graduates

330. Pharmacological Basis of Clinical Medicine. This course consists of a detailed analysis of the mechanism of action and rationale for use of pharmacologic agents in disease states. 4 units. *Schanberg and Staff*

331. Laboratory Methods in Pharmacology. Tutorial laboratory trainin will be given in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Certain special laboratory sessions will be conducted at the Wellcome Researc Laboratories, Research Triangle Park. Prerequisite: permission of instructor. 3- units. *Narahashi, Maxwell, and Staff*

342. Current Topics in Cardiac Muscle Physiology. Selected topics in th physiology and pharmacology of cardiac muscle, including general and comparativ morphology, ultrastructure of cardiac electrophysiology and mechanics, and excitation-contraction coupling. 2 units. *Johnson and Staff*

372. Research in Physiology and Pharmacology. Laboratory investigatio in various areas of physiology and pharmacology. Credits to be arranged. *Staf*

393. Integrative and Clinical Neurophysiology and Neuropharmacology Aspects of the physiology and pharmacology of the central nervous system i health and in disease: sensory coding; reflex functions; motor control; effects o drugs on the CNS; physiological aspects of memory. 3 or 4 units (extra unit available upon permission of instructor). *Somjen and Staff*

395. Biochemical Pharmacology. Emphasis on mechanism of action o drugs in the areas of (1) metabolism and toxicology; (2) antibiotics; (3) steroids (4) antimetabolites; (5) embryology and development; (6) hematopoietic systen and prophyrins; (7) lipids and carbohydrates; (8) membrane structure and functions; and (9) ground substance (mesenchyme). Lectures will be selected from th above areas and will correlate the material in terms of clinical significance. (Offered in alternate years beginning fall, 1973.) (Also listed as Biochemistry 395.) 2 units. *Appel, Elford, Hitchings, Kamin, Kirschner, Lack, Nichol, Posner, an Rosse*

401. Metabolic and Developmental Physiology and Pharmacology. Cel division and control of the cell cycle; population dynamics; physiology of subcellular organelles such as nuclei, mitochondria, lyosomes, and peroxisomes metabolic regulation with respect to temperature adaptation and a variations i exogenous substrates; control of development and differentiation in eucaryoti cells. Prerequisite: Biochemistry 247 or equivalent. 3 units. *Blum, Padilla, an Staff*

403. Endocrinology and Reproduction. See course description for Anatomy 403. (Also listed as Anatomy 403.) 3 units. *Anderson, Everett, and Fellow*

412. Advanced Seminar in Endocrinology and Reproductive Physiolog I. A weekly seminar based on student and faculty-led discussions of special topic in endocrinology and reproduction. Primarily designed for advanced students with active research interests relating to these areas of mammalian physiology. Prerequisites: Physiology 403 or equivalent and consent of instructor. 2 units. *Fellows, Anderson, Schomberg, Everett, Lebovitz, and Staff*

413. Advanced Seminar in Endocrinology and Reproductive Physiology II. A continuation of Physiology 412 with discussion of topics not covered in the fall term. Prerequisites: Physiology 412 and consent of instructor. 2 units. *Fellows, Anderson, Schomberg, Everett, Lebovitz, and Staff*

414. Analysis of Physiological Systems. Several physiological systems will be analyzed in detail using combination of classical mathematical analysis, model-building, and newer analog and digital techniques. Topics to be covered include diffusion processes; steady state, transient, and cable equations. (Alternate years beginning spring, 1974.) Prerequisite: permission of instructor. 3 units. *Moore and Blum*

416. Neuronal Physiology and Pharmacology. Structure and function of excitable membranes; impulse generation and conduction in different types of nerves; effects of pharmacological agents on electrical characteristics; physiological and pharmacological aspects of synaptic and neuromuscular transmission; biophysics of receptor cells. 3 units. *Narahashi, Moore, Wachtel and Wolbarsht*

420. Cellular Immunophysiology. The interaction of immunologically active macromolecules such as antibodies or plant agglutinins with membrane surfaces and the resulting effects on membrane function and cell physiology will be the principal topic of this course. Emphasis will be placed on immune reaction mediated permeability changes in red blood cells and certain nucleated mammalian cells as well as on antibody induced alterations of enzyme activities. (Also listed as Microbiology 420.) 2 units. *Lauf and Staff*

Political Science

Professor Barber, *Chairman* (214 Perkins Library); Associate Professor Fish, *Director of Graduate Studies* (308 Perkins Library): Professors Ball, Braibanti, Cleaveland, Cole, Cook, Grzybowski, Hall, Hallowell, Kornberg, Kulski, and Leach; Associate Professor Johns; Assistant Professors Eldridge, Hawley, Paletz, Spragens, Trilling, and Valenzuela

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government.

Fields in which instruction is at present offered are American government and politics (including constitutional law, public administration, the legislative and judicial processes, and state and local government); comparative government and politics (including Western Europe, Southern Asia, Latin America, Africa, the Soviet Union, and the Commonwealth); political theory; international relations (including international law and international organization); and empirical theory and methodology.

The candidates for the master's degree are required to show proficiency in one modern foreign language and to submit either a thesis or thesis equivalent. The latter option is open only to students going on for the Ph.D.

The candidate for the degree of Doctor of Philosophy in political science must elect four fields, at least three of which must be selected from the fields enumerated above and one of which must be in a related department. He must also demonstrate a reading knowledge of two foreign languages which have been approved by the professor who supervises his dissertation, or he must demonstrate proficiency in one such foreign language and in the use of statistics.

For Seniors and Graduates

207. American Constitutional Interpretation. Major constitutional issue approached through selected Supreme Court decisions illustrating the Court' role in the governing process. Prerequisite: Political Science 127 or its equivalent 3 units. *Fish*

209. Problems in State Government and Politics. 3 units. *Leach*

210. The Politics of Education. The forces in local, state, and nationa politics which impinge on educational administration. 3 units. *Leach*

214. Comparative Administrative Law. Comparative analysis of the role o administrative law and administrative techniques in established and transitiona constitutional systems. Emphasis on French, German, British, and American patterns. Control of legality and expediency of various types of judicial review wil be discussed. 3 units. *Grzybowski*

220. Problems in International Politics. Among the topics considered are nuclear power, bipolarity and polycentrism, nationalism, national interests and idealogy, the revolution of modernization, and regional integration. 3 units. *Kulski*

221. International Organization. The functioning of the United Nations system and of regional organizations operating in the political and security fields 3 units. *Ball*

222. Empirical Theory. Emphasis is on the theoretical status of contemporary conceptual frameworks which often rely on or generate empirical research. Prerequisite: Political Science 233 or consent of instructor. 3 units. *Trilling*

223. Political Philosophy from Plato to Machiavelli. An intensive analysis of the political philosophies of Plato and Aristotle followed by a survey of medieval political thought and an analysis of the significance of Machiavelli. 3 units. *Hallowell*

224. Modern Political Theory. An historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. 3 units. *Hallowell*

225. Comparative Government and Politics—Western Europe. Modern political institutions and processes in Western Europe. 3 units. *Cole*

226. Theories of International Relations. A survey of contemporary theories of international relations and foreign policy with an emphasis on the interdependence of theory and empirical research. 3 units. *Eldridge*

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. 3 units. *Grzybowski*

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, Nationalism, Facism and National Socialism, Existentialism, contemporary theories of democracy. 3 units. *Hallowell*

230. American National Government. A study of the formation, development, and contemporary operation of the national political system. The analysis employs both historical and behavioral approaches. 3 units. *Thomas*

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day. 3 units. *Cook*

233. Research Methodology. The research process in political science with emphasis on the construction and implementation of research designs. 3 units. *Trilling*

235. The Commonwealth. An analysis of the political relationship between the members of the Commonwealth and a comparative study of the political systems of the Commonwealth countries, with particular reference to Canada. A course designed in part to utilize the occasional services of visiting professors from Commonwealth countries. 3 units. *Cole*

236. Statistical Analysis. An introduction to the descriptive and analytical uses of statistics in political research. Prerequisite: graduate standing or permission of instructor. 3 units. *Trilling*

237. Problems in American Foreign Policy. The decision-making process as applied to contemporary foreign policy issues. (Offered in alternate years.) Prerequisite: Political Science 122 or the equivalent. 3 units. *Ball*

241. Public Administrative Organization and Management. An examination of the American administrative process, with emphasis upon the theory and practice of administrative organization and management. 3 units. *Hall*

243. Administrative and Organizational Theory. Alternative theories of human behavior and social systems that might explain the differential rates at which public organizations respond to the internal and external demands they experience. Substantial attention is given to evaluating contemporary strategies for reforming "people processing" institutions. 3 units. *Hawley*

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. 3 units. *Hall*

246. Administration and Public Policy. The role of the administrative official as a policy-maker in modern American politics. 3 units. *Hall*

249. Comparative Political Analysis and Political Development. General methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theories of political development. Flows of technology and social change. Theoretical problems of induced political change. 3 units. *Braibanti*

250. Comparative Government and Politics—Southern Asia. Political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional and institutional aspects of the political systems. Impact of foreign technical assistance. 3 units. *Braibanti*

253. Comparative Government and Politics: Latin America. An analysi of current publications in comparative politics, applicable to an understanding o the major themes of Latin American politics. 3 units. *Valenzuela*

260. The Tradition of Political Inquiry. A study of the problems, goals presuppositions, and methods of political inquiry, past and present. 3 units *Spragens*

271. Political Processes in Traditional and Modern Africa. An analysi of patterns of change in selected African societies from the pre-colonial to the post colonial period. The focus of the course will be upon the interaction between traditional, colonial, and post-colonial institutions and their impact upon Africar societies. (Also listed as History 219.) 3 units. *Johns*

274. Political Psychology. Psychological aspects of political performance by citizens, activists, and leaders. 3 units. *Barber*

275. The American Party System. An intensive examination of selectec facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, and the controversy over party government. 3 units. *Kornberg*

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. 3 units. *Kornberg*

279. The Legislative Process. A behavioral analysis of the American legislative process with emphasis on Congress. Some consideration will also be given to legislatures in other countries. 3 units. *Paletz*

280. Comparative Government and Politics—Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. 3 units. *Johns*

285. The Judicial Process. A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisites: Political Science 127 and 207 or their equivalents. 3 units. *Fish*

291. Problems of Urban Government. Analysis of problems in the structure and functions of urban governments in the United States. 3 units. *Leach*

293. Federalism. A study of the theoretical and operational aspects of federal systems, with emphasis in the United States, Canada, and Australia. (Offered in alternate years.) 3 units. *Leach*

For Graduates

310. Seminar in State and Local Government. (Offered in alternate years.) Prerequisites: Political Science 209 and 291 or their equivalents. 3 units. *Leach*

312. Seminar in Constitutional Law. Prerequisite: Political Science 207 or the equivalent. 3 units. *Fish*

313. Education and Public Policy. Seminar in the relationship of educational administration to the public policy process. 3 units. *Leach and Pittillo*

321. Seminar in Political Theory. (Offered in alternate years.) Prerequisites: 6 units in Political Science 223, 224, 229, 231 or the equivalents. 3 units. *Hallowell*

325. Seminar in Comparative Government and Politics. (Offered in alternate years.) Prerequisites: 6 units in Political Science 225, 249, 250, 251, 253, 280 or the equivalents. 3 units. *Cole*

328. Seminar in International Law. Prerequisite: Political Science 227 or the equivalent. 3 units. *Grzybowski*

329. Seminar in International Regional Organization. (Offered in alternate years.) Prerequisite: Political Science 221 or the equivalent. 3 units. *Ball*

330. Seminar in Comparative Government and Politics—Southern Asia. Emphasis on research using documentary materials relating to India. Pakistan, Ceylon, and Malaysia. Prerequisites: Political Science 250, 251, or the equivalents. (Offered in alternate years.) *Braibanti*

331. Seminar in American Political Thought. 3 units. *Leach*

341. Seminar in Public Administration. Selected topics in administrative and organizational theory and behavior. Prerequisite: Political Science 141 or 243. 3 units.

342. Seminar in American National Government and Politics. Prerequisite: Political Science 230 or its equivalent. 3 units.

343. Seminar in the Policy Process. Selected topics covering the theory, methodology, and practice of policy formation in American politics. Prerequisite: Political Science 246 or its equivalent. 3 units.

344. Workshop on Computer Models of Social Systems. (Also listed as Economics 344.) 3 units. *Naylor*

360. Seminar in Government and Politics in the Soviet Union. Prerequisite: Political Science 165, or on individual approval. 3 units.

361. Seminar in Foreign Relations of the Soviet Union. Prerequisite: Political Science 220 or 360, or on individual approval. 3 units.

376. Seminar in Comparative Political Behavior. An intensive comparative examination of the impact of selected political institutions on political behavior. (Offered in alternate years.) 3 units. *Kornberg*

377. Seminar in Canadian Political Behavior. Analysis of institutional processes and political behavior in Canadian society with special reference to the impact of multi-partyism, parliamentarianism, political, and cultural particularism, and the elite structure. (Offered in alternate years.) 3 units. *Kornberg*

380. Seminar in African Government and Politics. Prerequisite: Political Science 280 or its equivalent. 3 units. *Johns*

381. Seminar in Latin American Government and Politics. Prerequisite: Political Science 253 or the equivalent. (Offered in alternate years.) 3 units. *Valenzuela*

382. Soviet Law and Society. 2 units. *Grzybowski*

401. Seminar in the Commonwealth. 3 units. *Braibanti, Cole, and Preston*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holly, and Spragens*

Related Course Work in the School of Law

There may be graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this *Bulletin* under Academic Regulations.

Psychology

Professor Jones, *Chairman* (224 Psychology-Sociology Building); Professor Staddon, *Director of Graduate Studies* (242 Psychology-Sociology Building); Professors Alexander, Borstelmann, Brehm, Carson, Diamond, Guttman, Lakin, Lockhead, and Schiffman; Associate Professors C. Erickson, R. Erickson, and Wing; Assistant Professors Aderman, Coie, Costanzo, Hall, Kalat, Kremen, Norton, Robinson, and White; Lecturers Casseday, Clifford, E. Crovitz, H. Crovitz, I. Gehman, Gentry, Kinsbourne, Krugman, Obrist, Peele, Shows, Somjen, Thompson, and Wolbarsht

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

For Seniors and Graduates

203. Sensation and Perception. An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. 3 units. *Lockhead*

204. Comparative Psychology. An analysis of the ontogeny, evolution, adaptive significance, and physiology of animal behavior. 3 units. *C. Erickson*

210. Cognition and Higher Mental Processes. An analysis of selected research in thinking, problem solving, creativity, language, and related topics. 3 units. *Staff*

211. The Problem Child. See course description for Education 211. (Also listed as Education 211.) 3 units. *I. Gehman*

213. Adaptive Behavior. The principles of adaptive behavior, with special emphasis on the effects of reinforcement. Prerequisite: consent of instructor. 3 units. *Staddon*

215. Developmental Psychology. An examination of theoretical issues in identification, regression, and cognitive, moral, and motivational development. 3 units. *Staff*

216. Biological Psychology. The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include ablation method, method of evoked potentials, electrical stimulation of the brain, and classical and physiological genetics. 3 units. *Diamond*

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. 3 units. *Jones*

218. Research Methods in Social Psychology. The theory and practice of data collection methods in social psychology. Emphasis is on the interplay between experimental design and technique. 3 units. *Aderman*

219. Physiological Psychology I. The structure and function of the nervous system as related to problems of sensory-motor processes and learning. 3 units. *R. Erickson*

220. Physiological Psychology II. Examination of the role of nervous mechanisms and hormones in the control of goal-directed behavior and emotion. 3 units. *C. Erickson*

234. Seminar in Personality. A detailed consideration of selected research topics of current interest in the experimental study of personality, including risk-taking, creativity, and cognitive styles. 3 units. *Wallach*

236. Theoretical Psychology. Representative systematic formulations and schools in historical sequence. 3 units. *Guttman*

238. The Electroencephalogram and Psychological Function. A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, conditioning, and learning. Lectures, laboratory demonstrations, and clinical case presentations. 3 units. *Obrist*

239. Behavioral Correlates of Brain Damage in Man. A study of the effects of brain damage on psychological functioning. Known brain-behavior relationships in man will be reviewed, and problems encountered in the study of brain function in man will be emphasized. Laboratory demonstrations will be concerned with the assessment of cerebral dysfunction through the use of standard psychological tests. 3 units. *Thompson*

245. Personality Theory I. An examination of representative theories of human functioning from Freud through depth and neoanalytic approaches. 3 units. *Alexander and Kremen*

246. Personality Theory II. An examination of representative models of human functioning from among such approaches as that of field theory, behavior theory, type or trait theory, and ego psychology. 3 units. *Alexander, Kremen, and Schiffman*

271.1-4. Seminar in Selected Problems. 3 units each. *Staff*

271.5. Comparative Neurology and Psychology. See course description for Anatomy 271. (Also listed as Anatomy 271.) 3 units. *Hall*

273-274. Principles of Psychological Measurement. Measurement theory and the problems of scientific inference. Topics will include methods of data analysis, psychometric scaling, and test construction. Prerequisite: Mathematics 232 or equivalent. 3 units per semester. *Schiffman*

282. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research. Emphasis is on the application of principles drawn from theories of personality to individual and group psychotherapy. Includes some field experience in therapy. 3 units. *Carson and Lakin*

283, 284. The History of Psychology. First semester, Aristotle to Kant; second semester, development of modern psychology. Prerequisite for 284: Psychology 283 or permission of instructor. 3 units per semester. *Guttman*

291. Seminar in Community Mental Health. A study of psychological epidemiology and ecology; primary, secondary, and tertiary prevention; and the public health approach to problems of psychological well being. Focus on intervention techniques, such as consultation and community action planning. 3 units. *Staff*

293. Methods in Developmental Psychology. Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. 3 units. *Staff*

For Graduates Only

305. Psychopathology. An examination of behavior disorders, with particular emphasis on explanatory concepts and the evidence from research in this field. 3 units. *Staff*

306. Seminar in Developmental Psychology. Selected topics in cognitive, emotional and social development. 3 units. *Staff*

309. Seminar in Learning. Selected topics in operant conditioning and discrimination learning. 3 units. *Staddon*

310. Seminar in Perception. 3 units. *Lockhead*

313. Seminar on the Concept of the Reflex. A consideration of the reflexological principles found in the works of Sherrington, Sechenov. Pavlov, Eccles, Skinner, Konorski, *et al.*, and an examination of the critiques of Goldstein, Lashley, and others. 3 units. *Diamond and Guttman*

314. Seminar in Instrumental Behavior. 3 units.

316. Seminar in Social Psychology. 3 units. *Jones*

317. Seminar in Social Behavior. 3 units.

318. Seminar in Social Influence. 3 units. *Brehm*

319-320. Student-Faculty Research Conference. 6 units per semester. *Staff*

321. Seminar in Psychophysiology of Hearing. An examination of the relation of anatomy and physiology to psychophysics of the auditory system. Permission of the instructor. 3 units. *Casseday*

324. Seminar: Behavioral Studies of the Brain. Selected topics in the neural bases of behavior. 3 units. *Diamond and R. Erickson*

325. Seminar in Neuroendocrinology and Behavior. Selected problems in the study of hormones and neurohumors as they are related to such areas as reproductive behavior, sleep, and emotion. 3 units. *C. Erickson*

327, 328. Foundations of Clinical Psychology. A review in depth of selected issues, concepts, and empirical findings of general psychology that have immediate or potential relevance to the theory and practice of clinical psychology. The several subdisciplines of psychology—e.g., social, developmental, biological—will be scanned so as to identify content areas that intersect with or have implications for the concerns of clinical-personality psychology. 3 units per semester. *Carson and Staff*

329-330. Seminar in Psychology. An intensive examination of original sources in experimental and biological psychology. Ordinarily taken by all students in the natural science division in their first year of residence. 6 units. *Staff*

335-336. Clinical Inquiry I. This course focuses on the process of understanding intra- and inter-person systems, largely in a practicum context. 6 units. *Staff*

337. Seminar in Sensory Discrimination. The neural bases of discrimination in vertebrates and invertebrates is studied by neurophysiological, electrophysiological, and psychophysical techniques. 3 units. *R. Erickson and Wolbarsht*

340. Group Processes and Sensitivity Training. 3 units. *Lakin*

343, 344. Clinical Inquiry II. Intensive experience and supervision in techniques of psychotherapy and behavior modification. 3 units per semester. *Staff*

347-348. Personality Assessment. Introduction to the assessment of human personality through the study of personal documents, interview data, objective and projective test material. Laboratory sessions will be concerned with personality assessment of normal human subjects over extended time periods. 6 units. *Alexander and Kremen*

350. Practicum in Psychological Research. Ordinarily taken by all students in the natural science division in their first semester of residence. 3 units. *Staff*

Religion

Professor Poteat, *Chairman;* Professor Young, *Director of Graduate Studies* (209 Divinity School); Professors Baker, Beach, Bradley, Cushman, Davies, Henry, Herzog, Lacy, Langford, Murphy, Osborn, Price, and M. Smith; Associate Professors Bailey, Clark, Kort, Meyers, Partin, Robinson, H. Smith, Steinmetz, and Wintermute; Assistant Professor Charlesworth

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) Biblical studies; (2) historical studies; and (3) systematic and contemporary studies. They will be expected to take such courses in one or both of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as Classical Studies, History, Political Science, or Sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

FIELD I. BIBLICAL STUDIES

207. Second Hebrew. Historical Hebrew grammar with reading and exegesis of Old Testament prose (Pentateuch and historical books in alternate years). First semester. 3 units. *Wintermute*

208. Second Hebrew. Historical Hebrew grammar and rapid reading of prose and poetry. Second semester. 3 units. *Murphy*

209. Old Testament Theology. Studies of the Old Testament in regard to theological themes and content. 3 units. *Murphy*

223A. Exegesis of the Hebrew Old Testament: Amos and Hosea. Interpretation based upon Hebrew exegesis, stress upon hermeneutic methods. 3 units. *Bailey*

223B. Exegesis of the Hebrew Old Testament: Job. 3 units. *Murphy*

223C. Exegesis of the Hebrew Old Testament: Exodus. 3 units. *Bailey*

225. Living Issues in New Testament Theology. Critical examination of major problems and issues in New Testament interpretation and theology. 3 units. *M. Smith*

226A. Exegesis of the Greek New Testament I (Mark and Matthew). 3 units. *Price or Smith*

226B. Exegesis of the Greek New Testament I (Romans). 3 units. *Price*

226D. Exegesis of the Greek New Testament I (I and II Corinthians). 3 units. *M. Smith*

226E. The Gospel and Epistles of John. Exegesis of the Johannine literature in Greek. 3 units. *M. Smith*

227A. Exegesis of the Greek New Testament II (Luke-Acts). 3 units. *Young*

227B. Exegesis of the Greek New Testament II (Galatians). 3 units. *Smith*

227C. Exegesis of the Greek New Testament II (The Pastoral Epistles). 3 units. *Young*

228. The Theology of the Gospel and Epistles of John. A study of the origin of these writings; the provenance of their thought forms and symbolism; their influence on the early church; and contemporary significance. 3 units. *Price*

237. History of the Ancient Near East. A specialized study of the civilizations of Egypt, Palestine, Syria, and Mesopotamia in the light of Biblical archaeology. 3 units. *Bailey*

258. Coptic. Introduction to the Sahadic dialect with selected readings from Christian and Gnostic texts. Prerequisite: at least one year of Greek. 3 units. *Wintermute*

302. Studies in the Intertestamental Literature. Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to post-exilic Judaism. Prerequisite: permission of instructor. 3 units. *Charlesworth*

304. Aramaic. A study of the Aramaic portions of the Old Testament and selected passages from the Targums, Midrash, and Talmud. 3 units. *Meyers or Murphy*

304A. Targumic Aramaic. An introduction to the language and literature of the Aramaic translations of the Old Testament. 3 units. *Meyers*

305. Third Hebrew. An interpretive study of late Hebrew prose, with readings from Chronicles, Ecclesiastes, and the Mishnah. 3 units. *Davies or Meyers*

306. Language and Literature of the Dead Sea Scrolls. A study in interpretation. Prerequisite: a knowledge of Hebrew. 3 units. *Charlesworth*

307. Syriac. A study of the script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. 3 units. *Charlesworth*

311. Pharisaic Judaism in the First Century. A reading course in first-century Pharisaic Judaism. 3 units. *Davies*

312. Pauline Theology. Studies in aspects of Paulinism in the light of recent scholarship. 3 units. *Davies*

314. Judaism and Christianity in the New Testament. Their interaction. 3 units. *Davies*

319. The Gospel According to St. Matthew in Recent Research. 3 units. *Davies*

323A. Comparative Semitic I. An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Mesopotamia, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

323B. Comparative Semitic II. An introduction to the morphology and syntax of classical Ethiopic and the Semitic languages of Palestine-Syria, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

340-341. Seminar in the New Testament. Research and discussion on a selected problem in the Biblical field. 3 units per semester. *Price, Smith, and Young*

342. The Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Prerequisite: reading knowledge of Hebrew, Aramaic, and Greek. 3 units. *Meyers*

345. The Epistle to the Hebrews in Recent Research. Intensive attention to the text and to secondary sources. 3 units. *Davies*

350-351. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. 3 units per semester. *Murphy*

373-374. Elementary Akkadian. Study of the elements of Akkadian grammar. Reading of neo-Assyrian texts shedding light on the Old Testament. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

375-376. Elementary Ugaritic. Study of the elements of Ugaritic. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

401. Colloquium in Biblical Studies. A colloquium in which all graduate faculty and students in the Biblical division participate. Research papers in the Biblical field are read and discussed.

FIELD II. HISTORICAL STUDIES

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. 3 units. *Lawrence*

218. Religion in Japan. A survey of religion in Japan, with special emphasis on indigenisation and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. 3 units. *Corless*

236. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. 3 units. *Steinmetz*

241. Problems in Reformation Theology. 3 units. *Steinmetz*

251. The Counter-Reformation and the Development of Catholic Dogma. An advanced survey of the main trends in Catholic theology from the death of Ockham to the Second Vatican Council. 3 units. *Steinmetz*

260. Seminar: Wesley Studies. The lives and thoughts of John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. 3 units. *Baker*

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. 3 units. *Partin*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions. Particular attention will be given to religious pilgrimage. 3 units. *Partin*

283. Religions of East Asia. A study of the major tradition of China and Japan, with emphasis on the development and expansion of Buddhism. 3 units.

284. The Religion and History of Isalm. A study of the origins and development of the Islamic tradition and community, with particular attention to the religious element. 3 units. *Partin*

285. The Vedic Tradition: Its Compilation and Interpretation. A study of Indian canonical writings, with emphasis on the literary stages and relation of the writings to later philosophical and religious movements. 3 units. *Lawrence*

289. World Religions and Social Change. The role of religious traditions and institutions in national and international affairs. Intensive study of selected areas of Asia and Africa, with special stress on missionary religions and political change. 3 units. *Bradley*

296. Religion on the American Frontier. A study of the spread of evangelical Christianity as a theological and cultural phenomenon of the American West. 3 units. *Henry*

308. Greek Patristic Texts. Critical translation and study of selected Greek texts illustrative of significant aspects of patristic theology and history from the second through the fifth century A.D. 3 units. *Young*

313. The Apostolic Fathers. A study of the religious thought in the writings of the Apostolic Fathers. 3 units. *Young*

315-316. Seminar: History of Religions. Selected problems in the field. 3 units.

317. Seminar in the Greek Apologists. A study of the apologetic writings of the Greek Fathers in relation to the challenges of their contemporary world. Special attention will be given to leading protagonists of late Graeco-Roman culture, such as Celsus, Porphyry, and Julian. 3 units. *Young*

318. Seminar in the Greek Fathers. A study of selected topics from the Greek Fathers. 3 units. *Young*

331. The Social Message of the Early and Medieval Church. A study of the social teachings and contributions of the Christian Church prior to the Protestant Reformation. 3 units.

332. The Medieval Church. Outstanding characteristics of the medieval Church, emphasizing theory, polity, institutions, sacraments, and worship. 3 units.

334. Church Reformers and Christian Unity. The work of such reformers as Marsilius of Padua, William of Ockham, Jean Gerson, Pierre d'Ailly, and Nicholas of Cusa in relation to ecclesiastical schism and the search for Christian unity through representative councils. 3 units.

335. The English Church in the Eighteenth Century. Studies of Christianity in England from the Act of Toleration, 1689, to the death of John Wesley, 1791. 3 units. *Baker*

336. Christian Mysticism in the Middle Ages. Source studies in historical perspective of such late medieval mystics as Bernard of Clairvaux, the Victorines, Ramon Lull, Meister Eckhart, Richard Rolle, Catherine of Siena, and Nicholas of Cusa. 3 units.

338. Calvin and the Reformation in Switzerland. The theological development of John Calvin. A comprehensive examination of his mature position with constant reference to the theology of the other reformers. 3 units. *Steinmetz*

339. The Radical Reformation. Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Müntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marpeck, Socinus, and Menno Simons. 3 units. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. Source studies in th early Reformed tradition. 3 units. *Steinmetz*

377. Contemporary American Dramatic Arts and Evolving Theologica Forms. An examination of creed and ritual implicit and explicit in contemporar American theater, film, and television. 3 units. *Henry*

384. Religious Dissent in American Culture. History and significance o dissent in the theology and culture of America. 3 units. *Henry*

385. Religion in American Literature. A critical study of the meaning an value of religious motifs reflected in American literature. 3 units. *Henry*

391. Historical Types of Christian Ethics I. A critical study of representative statements of Christian ethical theory, through the early Reformation. 3 units. *Beach*

392. Historical Types of Christian Ethics II. A continuation of Religion 391, from the Reformation through current Christian ethical theory. Prerequisite: Religion 391. 3 units. *Beach*

395. Christian Thought in Colonial America. Exposition of the main currents in Protestant theology. 3 units. *Henry*

396. Liberal Traditions in American Theology. A study of the main types of modern religious thought, beginning with the theology of the Enlightenment. 3 units. *Henry*

FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology. A study of twentieth-century British theology. Attention will be given to the Anglican, Free Church, and Scottish traditions. 3 units. *Langford*

211. Authority in Theology. The idea and function of authority in theology. 3 units. *Langford*

230. The Meaning of Religious Language. An analysis of the credentials of some typical claims of theism in the light of theories of meaning in recent thought. (Also listed as Philosophy 230.) 3 units. *Poteat*

231. Seminar in Christianity and Contemporary Thought. Analytical reading and discussion of such critical cultural analysis as is found in the works of M. Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. 3 units. *Poteat*

232. Religion and Literature: Perspectives and Methods. A study of literary works and their religious origins, parallels, and implications as analyzed and interpreted by myth or archetype critics and by theological critics. 3 units. *Kort*

233. Modern Narrative and Religious Language. A study of the fiction of selected American, British, and Continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. 3 units. *Kort*

248. The Theology of Karl Barth. An historical and critical study of the theology of Karl Barth. Prerequisite: permission of the instructor. 3 units. *Osborn*

249. The Church in Contemporary Theology. A critical and systematic study of the doctrine of the Church in contemporary Christian thought. 3 units. *Osborn*

281. Phenomenology and Religion. Scheler, E. Strauss, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. Prerequisite: permission of instructor. 3 units. *Poteat*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions. Particular attention will be given to religious pilgrimage. 3 units. *Partin*

292. Christian Ethics and International Relations. An examination of Christian attitudes toward such issues as war and peace, the rule of law, foreign aid, and human rights; and the Church's contribution to international policies and institutions. 3 units. *Lacy*

293. Sociological Analysis of Religion. An analysis of the way in which various components of a religion (belief-systems, liturgical practices, ethical teachings, institutional structure, and modes of operation) function in relation to social cohesion, social conflict, and social reform. 3 units. *Clark*

294. Institutional Analysis of Religious Bodies. A study of the internal structure and dynamics of religious groups. 3 units. *Clark*

295. Ethics and Economic Life. A survey of the historical teachings of the Christian churches in the areas of economic life, an analysis of contemporary norms of economic justice, and an exploration of current public and private economic policies and the policy-making processes. 3 units. *Clark*

300. Systematic Theology. Method and structure of systematic theology, the doctrine of God, theological anthropology, and Christology. 3 units. *Cushman, Herzog, and Langford*

303. The New Hermeneutic and the Idea of History. A critical examination of key thinkers in present-day European systematic theology (Fuchs, Ebeling, Moltmann, Ott, and Pannenberg) in the light of Ernest Bloch's philosophy. 3 units. *Herzog*

320. Hegel and Schleiermacher. A study of two makers of modern Protestant thought. 3 units. *Herzog*

322. Nineteenth Century European Theology. Protestant theology from Kant to Herrmann. 3 units. *Herzog*

325. Philosophical Theology I. Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. 3 units. *Cushman*

326. Philosophical Theology II. Continuation of Philosophical Theology I. 3 units. *Cushman*

328. Twentieth-Century European Theology. Critical examination of the thought of selected Protestant theologians from 1900 to 1950. 3 units. *Herzog*

333. Marxist Ideology and Christian Faith. Comparative study of Communist and Christian doctrines of man, society, sin, history, ethics, and eschatology. 3 units. *Lacy*

361. Language and Biblical Criticism. An attempt to explore the bearing of recent investigators into the nature of language upon problems in the study of Biblical texts. Prerequisite: permission of both instructors. 3 units. *Poteat and Charlesworth*

380. Existentialist Thought. An exploration of the interests and motifs of Existentialism in relation to modern philosophy and theology through an analysis of representative writings of Kierkegaard, Heidegger, Berdyaev, Marcel, and Sartre. 3 units. *Poteat*

383. Moral Theology in the Twentieth Century. Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. 3 units. *H. Smith*

386. Christianity in Dialogue with Other Faiths. Contemporary currents of Christian thought as they affect resurgent non-Christian faiths, new formulations of a theology of mission, and ecumenical conversations. 3 units. *Lacy*

388. Ethics and Medicine. A critical study of selected aspects of modern biomedical technology, with special reference to the ethical assumptions informing their development and practice. 3 units. *H. Smith*

389. Christian Ethics and Contemporary Culture. A study of the interaction between Christian thought and current social theory. 3 units. *Beach*

390. Current Problems in Christian Ethical Theory. A critical study of dominant issues in Christian ethics, such as community, conscience, contextualism, power, and technology. 3 units. *Beach*

394. Christianity and the State. The relation of the Christian theory of the State to political problems, with special consideration of the religious assumptions underlying democratic theory and practice and of the relationship of church to state. 3 units. *Beach*

397. Contemporary American Theology. A critical appraisal of major tendencies. 3 units. *Henry*

398. Colloquium on the College and University Teaching of Religion. The theological issues of religion in higher education; a consideration of the curricular content of religion courses. Normally expected of Level III students in Fields I, II, and III in residence. *Young and Staff*

Romance Languages

Professor Fein, *Chairman* (205 Foreign Languages); Associate Professor Vincent, *Director of Graduates Studies* (214 Foreign Languages); Professors Cordle, Davis, Fowlie, Niess, Predmore, Tetel, and Wardropper; Associate Professors Hull and Stewart; Assistant Professors Auld and Caserta

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. will minor in a second Romance language; however, minor work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours or (equivalent) above the intermediate level in the major language.

FRENCH

For Seniors and Graduates

209. Advanced Composition and Syntax. A systematic study of the differences between French and English patterns of expression; practice in writing various styles of French. 3 units. *Hull*

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. 3 units. *Hull*

213, 214. French Literature of the Seventeenth Century. First semester: theatre. Readings in the dramatic literature of the century. Second semester: prose and non-dramatic poetry. Readings in baroque and *precieux* poetry, the novel and the *moralistes*. 3 units per semester. *Auld*

217. French Symbolism. The poetry and theories of Baudelaire, Mallarmé, and Rimbaud. Decadence: Lautréamont and Laforgue. *Fowlie*

219. Old French Literature. An introduction to the reading of Old French literary texts. 3 units. *Vincent*

221, 222. The Nineteenth-Century French Novel. First semester: Romanticism and Romantic Realism, studied especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. 3 units per semester. *Niess*

223. French Literary Criticism. A history of critical theory in France and a study of the major critics from the Renaissance to today. 3 units. *Fowlie*

224. History of the French Language. The evolution of French from Latin to its present form; internal developments and external influences. 3 units. *Hull*

225, 226. From Renaissance to Baroque in French Literature of the Sixteenth Century. First semester: literary prose. Readings from Jean Lemaire de Belges, Marguerite de Navarre, Rabelais, Montaigne, and others. Second semester: poetry and theater. Readings from Marot, Scève, Labé, Saint Gelais, the Pléiade, d'Aubigné, Sponde, Du Bartas, Garnier, and others. 3 units per semester. *Tetel*

228. French Poetry of the Twentieth Century. In the wake of symbolism; Valéry and Claudel; poetry as ritual, Péguy; Apollinaire and surrealist poetry; the contemporary movement, Michaux, Char, Saint-John Perse. 3 units. *Fowlie*

233. Contemporary French Theater. A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. 3 units. *Fowlie*

234. Proust. A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. 3 units. *Fowlie*

241, 242. French Literature of the Eighteenth Century. First semester: the literature of the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. 3 units per semester. *Stewart*

245, 246. French Literature of the Twentieth Century. First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman.* 3 units per semester. *Cordle*

For Graduates

311, 312. French Seminar. Each semester one of the following topics wil be selected for intensive treatment: studies in sixteenth-century literature, studies in eighteenth-century literature, studies in nineteenth-century literature, studies in seventeenth-century literature, studies in contemporary literature, and studies in medieval literature. 3 units per semester. *Auld, Cordle, Fowlie, Niess, Stewart Tetel, and Vincent*

———. Graduate Reading Course. An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only No credit.

ITALIAN

For Seniors and Graduates

283. Italian Novel of the Novecento. Currents in Italian fiction and representative works of novelists from Svevo to the most recent trends and writers. units. *Caserta*

284. Dante. *La Vita Nuova* and a close reading of the *Inferno.* (Conducted in English.) 3 units. *Fowlie*

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. 3 units. *Tete*

SPANISH

For Seniors and Graduates

251. The Origins of the Spanish Novel. A critical study, based on close reading and discussion, of selected examples of the principal genres of the early novel: the *Amadís de Gaula,* Diego de San Pedro's *La cárcel de amor,* the *Abencerraje,* the *Lazarillo,* Montemayor's *Diana.* 3 units. *Wardropper*

252. Spanish Lyric Poetry Before 1700. A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor, la poesía de tipo tradicional* and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de León, and Herrera; on Góngora and Quevedo. 3 units. *Wardropper*

253. The Origins of the Spanish Theater. A study of the evolution of the Spanish theater from *Auto de los Reyes Magos* (twelfth century) through the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vicente, Torres Naharro, Lope de Rueda, Juan de la Cueva. 3 units. *Wardropper*

255, 256. Modern Spanish American Literature. First semester: poetry from *Modernismo* to the present. Second semester: twentieth-century fiction. units per semester. *Fein*

257. Old Spanish. The historical development of the language together with illustrative readings. 3 units. *Davis*

258. Old Spanish Literature. An introduction to the reading of medieval Spanish literary texts. 3 units. *Davis*

259. Spanish Phonetics. A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. 3 units. *Predmore*

261. Nineteenth-Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibánez, and their contemporaries. 3 units. *Davis*

262. Galdós. Works selected from the *Novelas contemporáneas,* the *Episodios nacionales,* and his drama. 3 units. *Davis*

265. Golden Age Literature: Cervantes. The life and works of Cervantes with special emphasis on his *Quijote.* 3 units. *Predmore and Wardropper*

266. Golden Age Literature: The Drama. Study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. 3 units. *Wardropper*

275, 276. Contemporary Spanish Literature. First semester: the essay and lyric poetry. A study of the revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: the novel. A study of tradition and innovation in the twentieth-century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle, Inclán, and Pérez de Ayala. 3 units per semester. *Predmore*

For Graduates

321, 322. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and Baroque, studies in Spanish poetry, studies in nineteenth-century Spanish literature, and studies in twentieth-century literature. 3 units per semester. *Davis, Fein, Predmore, and Wardropper*

ROMANCE LANGUAGES

218. The Teaching of Romance Languages. Evaluation of objectives and methods; practical problems of language teaching at the elementary, secondary, and college levels; analysis of textbooks, tests, and audiovisual aids; applied linguistics. 3 units. *Hull*

Slavic Languages and Literatures

Associate Professor Krynski, *Chairman* (314 Foreign Languages); Associate Professor Jezierski, *Director of Graduate Studies* (321B Foreign Languages); Associate Professor M. Pavlov

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

For Seniors and Graduates

201, 202. The Novelists of Nineteenth-Century Russia. Development of the Russian novel against the European background, with emphasis on Dostoevsky and Tolstoy. Extensive readings in English. 3 units per semester. *Krynski*

***205. The Structure of Polish in Relation to Russian.** Comparative and contrastive study of the two major Slavic languages. Considerable emphasis placed on preparing students to read Polish literary texts. 3 units. *Krynski*

206. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski, and short stories by Slawomir Mrozek and Marek Hlasko. 3 units. *Krynski*

207. Soviet Literature and Culture. Literature since 1917, as a continuation of nineteenth-century traditions and as a response to Soviet ideology. Readings (in English or Russian) from major works of prose, poetry and drama. 3 units. *Jezierski*

212. Pushkin. A survey of his life and works, with attention given to his role as a precursor of modern Russian Literature. Readings in English or Russian. Prerequisite: Russian 101, or consent of the instructor. 3 units. *Krynski*

213. The Slavs: Literature and Culture, 1918-1939. Study of the cultures of Poland, Czechoslovakia, Yugoslavia, and Bulgaria using representative literary masterpieces. Comparative and contrastive study with attention to the Soviet influences. Readings in English. (Also listed as Comparative Literature 213.) 3 units. *Krynski*

214. The Slavs: Literature and Culture, 1940-1970. Study of the cultures of Poland, Czechoslovakia, Yugoslavia, and Bulgaria using representative literary masterpieces. Comparative and contrastive study with special emphasis on the process of cultural de-Stalinization both in Eastern Europe and in the Soviet Union. Readings in English. (Also listed as Comparative Literature 214.) 3 units. *Krynski*

215, 216. Advanced Composition and Syntax. A detailed study of the morphological and syntactic structure of modern Russian. Compositions based on literary topics. Prerequisites: Russian 91, 92 or instructor's permission. 3 units per semester. *Pavlov*

***224. The Russian Short Story—Eighteenth Century to the Present.** Readings of stories by such masters of the genre as Pushkin, Gogol, Turgenev, Tolstoy, Dostoevsky, and Chekhov. Readings in English and in Russian. 3 units. *Jezierski*

225. Tolstoy. A study of his life and works. The novels, short fiction, plays, and other writings considered in the light of his world significance. 3 units. *Jezierski*

* Not offered in 1973-74.

***227. Gogol.** Life and works: short stories, dramas and the novel. Readngs in English and in Russian. 3 units. *Jezierski*

230. Chekhov and the Russian Prose of the Turn of the Century. Strucural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, Symbolist, and Decadent trends in Russian prose. 3 units. *Krynski*

232. Dostoevsky. A close examination of his major fiction. 3 units. *Jezierski*

***236. Russian and Polish Romanticism.** Prose, poetry, and drama of such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski presented against the background of the Romantic movement in Western Europe. 3 units. *Krynski*

Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology Building); Associate Professor Wilson, *Director of Graduate Studies* (271 Sociology-Psychology Buildng); Professors Back, Maddox, McKinney, Myers, Palmore, Preiss, Roy, Smith, and Tiryakian; Associate Professor Simpson; Assistant Professors Brehm, Hartford, Hirschman, House, and Mason

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admision should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Candidates for the Ph.D. degree in sociology are expected to demonstrate in qualifying and preliminary examinations a broad background in the various aspects of sociology—substantive, theoretical, and empirical. The program of each candidate is determined by a committee which reviews his previous work and sets the pecific requirements to be met. These requirements will include work in related ields such as anthropology, economics, mathematics, philosophy, political science, or psychology. Emphasis is placed on the completion of the dissertation, directed by a member of the staff, demonstrating competence and independence in the investigation of an original and significant problem.

Further details of this program, the departmental facilities, the staff, and various stipends available, are described in a brochure which may be obtained rom the Director of Graduate Studies.

For Seniors and Graduates

225. Medical Sociology. A review and critique of current issues in the organization and development of resources for health care and of factors associated with the utilization of these resources. 3 units. *Maddox*

241. Social Stratification. The nature of hierarchial and vertical differentiaion in the economic, political, and prestige structures in modern societies. The nterrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The tran mission of inequality from one generation to the next. 3 units. *Mason and Roy*

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* Not offered in 1973–74.

242. The Sociology of Occupations and Professions. The social signif cance of work. Analysis of forces changing the contemporary occupational stru ture, typical career patterns of professions and occupations, the social organizatio of occupational groups. 3 units. *Simpson*

243. Population Dynamics and Social Change. Introduction to dem graphic analysis. The relationship between the demographic structure of society an its social organization. 3 units. *Hartford and Myers*

247. Community and Society. This course seeks to provide a frame reference for the analysis and ordering of facts pertaining to the diverse culture of the world, the State, the world community, the Great Society, news, mass be havior, social problems, races, and classes. 3 units. *Staff*

251. The Sociology of Modernization. Changes, obstacles to change, an structural strains which occur in kinship, stratification, bureaucracy and the rol of the military, occupations and work, communications, and values and ideologie during modernization. 3 units. *Hirschman and Tiryakian*

253. Social Institutions. The study of particular institutions and th social movements out of which they developed, with emphasis on the developme of general propositions concerning the nature, function, and importance of institu tions in society. 3 units. *Staff*

255. Race and Culture. A comparative study of race relations in worl perspective developed around such themes as races and personal identity, th geography and ecology of race relations, the idea of race, and race conflict. 3 unit *Hirschman and Palmore*

259. Religion and Social Change. A study of the role of religion in signif cant social changes in Western and non-Western societies. Emphasis given to no institutional phenomena (charisma, prophecy, messianism, revivals, glossolalia) Prerequisite: Anthropology 264 or Sociology 151, or the equivalent. 3 unit *Tiryakian and Wilson*

272. The Socialization Process. A consideration of the universal societ requirement for replacement of socialized personnel with major concentration the process in Western society. Particular attention is given to variations in s cialization by position in the social structure (class, caste, urban-rural) and to t contributions made by various socialization agencies (family, school, peer group mass media). 3 units. *Kerckhoff*

275. Social Attitudes and Individual Behavior. Such issues as the follo ing are considered: the importance of symbolic interaction, the development of th "self," the social structuring of the socialization process, individual moveme within the social structure, and the importance of membership groups and refe ence groups. 3 units. *Back and Kerckhoff*

278. Social Structure and the Life Cycle. A study of the relationshi between age as a social characteristic and social interaction, with particular re erence to adolescence and old age. 3 units. *Maddox*

295. Methodology in Sociology. Considerations of the nature of scie tific method, as well as alternative paths to knowledge, as they apply to sociolog

Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation both on the general level of research design and the specific level of special techniques. The process and logic of data analysis. Relations of theory and research are stressed. 3 units. *Back, Mason, and Smith*

297. Statistical Analysis in Sociology. Such techniques as zero and higher order linear and curvilinear correlation, partial correlation, analysis of variance and covariance and factorial design are studied. Where possible, analogous nonparametric techniques are also considered. 3 units. *Brehm, Hartford, and Mason*

298, 299. Seminar in Selected Topics. Substantative, theoretical, or methodological topics. 3 units each course. *Staff*

For Graduates

301. Seminar in Human Fertility. Special topics in human fertility including: theory of demographic transition, fertility in Latin America, design and evaluation of family planning programs, fertility and problems of modernization, and family structure and fertility. 3 units. *Back and Hartford*

302. Seminar in Migration. Special topics in migration including: Latin American rural-urban migration, urban migration policy, contemporary migration theories, and international migration. 3 units. *Hartford, Myers, and Smith*

325. Social Aspects of Mental Illness and Treatment. An examination and critique of sociological research and theory in the epidemiology, etiology and treatment of mental illness. Such topics as the effect of mental illness on the family, the structure and function of various treatment systems, and major problems of methodology will receive emphasis. 3 units. *Back and Preiss*

341. Special Problems of Complex Systems. Industrial and Professional Systems. Analysis of problems of organization of work in such diverse settings as industrial plants, hospitals, and public administration groups. Problems of decision-making, recruitment, allocation of authority, informal organization, interorganizational relations. 3 units. *McKinney and Roy*

Mass Communications. Theoretical problems in defining and distinguishing communication, communicative acts, communication processes, and communication systems. Work aimed toward the derivation of models and theories for each of these will be pursued. Students must have permission of the instructor. 3 units. *Smith*

Urban Society. Analysis is made of the varying mechanisms through which urban society in integrated, how urbanites develop a sense of identification with the community, and the extent and mode of social dominance of the city in the larger society. 3 units. *Myers and Smith*

Human Ecology. An examination of such issues as the logic and utility of the ecological approach; the possibility of testing current ecological theories in non-Western, non-urban environment; alternative explanations for the spatial patterning of social phenomena; selected methodological problems. 3 units. *Myers and Smith*

344. Workshop on Computer Models of Social Systems. The methodology of building mathematical and logical models of social systems and computer simulation experiments with such models. The types of models and social systems surveyed have applications in business administration, economics, education, political science, psychiatry, psychology, and sociology. Participants in the workshop will develop and conduct simulation experiments with a model of some complex social system, such as a city, state, region, or nation. 3 units. *Naylor*

345, 346. Demographic Techniques I and II. Measurement and methodology in demography. The first course will deal primarily with basic measurement techniques including standardization, construction of the life table, perio and cohort measures of fertility, and introduction to classical population theor The second will be devoted to the analysis of complex models such as famil building models and growth and projection models and the preparation of a research topic. 3 units per semester. (Also listed as Economics 345, 346.) *Hartfor and Myers*

351, 352. Seminar in Social Organization. Examination of such problems as the bases of social cohesion and continuity, the sources and effectivenes of social control mechanisms, the problem of social change in structural-functiona theory. 3 units per semester. *Maddox and McKinney*

361. Seminar in Comparative Sociology. Major emphasis on the relevanc of evolutionary, functional, and structural theories for explaining the findings o comparative studies. 3 units. *Hirschman, Myers, and Smith*

373, 374. Social Psychological Issues in Sociology. Detailed exploration of selected problem areas such as the theory and measurement of social attitudes, role discontinuity and personality disorders, applications of reference grou theory, the socialization process. 3 units per semester. *Back, Kerckhoff, an Preiss*

381. Development of Sociological Theory. An analysis of the development, convergence, and utilization of sociological theory. 3 units. *McKinney Tiryakian, and Wilson*

385. Seminar in Sociological Theory. Analysis of methodological an substantive problems in utilizing comprehensive, middle-range, and discrete theorie in varied sociological areas. Major emphasis on the use of theory in empirica research. Prerequisite: Sociology 381 or equivalent. 3 units. *McKinney*

386. Seminar in Sociological Theory. Focuses on the theoretical an research implications of existential phenomenology, drawing from such sources a Husserl, Merleau-Ponty, and Schutz. Attention will be given to recent sociologica interests in this area (e.g., ethnomethodology). Prerequisite: Sociology 381 o equivalent. 3 units. *Tiryakian*

390. Seminar in Field Methods of Sociological Research. The primar aims of this course will be two-fold, (a) to consider at length and in detail variou procedures and problems of observing human behavior in natural group, organizational, and community settings, and (b) to give the neophyte researcher elementar training in first-hand observation and face-to-face interviewing. 3 units. *Ro and Schneller*

392. Individual Research in Sociology. Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choic The process must be completed by preparation of a report on this research i adequate professional style. Prerequisite: Sociology 295 or permission of th instructor. 3 units. *Back, Mason, and Smith*

397, 398. Seminar in Special Research Problems. Treatment in depth of either selected methodological issues and/or methods. Examples of possible topics include scaling, methods of machine data processing, validation and induction, theory construction, quantification, interviewing, measurement, sampling plans, development of research designs from statistical models, methodological research, experimental techniques, demographic techniques, the relation of theory to research, and the role of statistical methods in sociology. Prerequisite: permission of instructor. 3 units each semester. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Zoology

Professor Fluke, *Chairman* (227 Biological Sciences Building); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences Building); Professors Bailey, Bookhout, Buettner-Janusch, Costlow, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, and K. Wilbur; Associate Professors Barber, Gillham, Tucker, Vogel, and Ward; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Forward, Lundberg, McClay, Sutherland, and H. Wilbur

The Department of Zoology manages a variety of programs tailored to individual needs to students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For Seniors and Graduates

201. Animal Behavior. A review of the major developments in the field, with emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics and evolution, or consent of instructor. 3 units; 4 units with laboratory. *Klopfer*

202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary and ecological studies with primary emphasis on marine groups. Lectures and laboratory. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. *Salmon*

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra and interspecific relationships; community ecology. Readings, discussion, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology or the equivalent, and a year of mathematics, some knowledge of statistics will be helpful. (Given at Beaufort.) 6 units. *Sutherland*

204. Population and Community Ecology. Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or permission of instructor. 4 units. *H. Wilbur*

205. Elements of Theoretical Biology. An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: introductory college biology and mathematics, or consent of instructor. 3 units. *Gregg*

212. Marine Membrane Physiology. See course description for Physiology 212. (Also listed as Physiology 212.) (Given at Beaufort.) 6 units. *Gutknecht, Schoffeniels, Wachtel, and Staff*

213. Ecological Oceanography. Population ecology and energy relationships of life in the open ocean. Lectures, seminars, and some sea-time. Prerequisites: courses in ecology or invertebrate zoology, chemistry, and calculus; a course in differential equations is strongly recommended. 3 units. *Staff*

214. Biological Oceanography. Composition in time and space of marine biosphere in relation to descriptive marine chemistry, physics, and geology. Some work at sea aboard the research vessel. Prerequisites: a course in invertebrate zoology, ecology, marine biology or an appropriate equivalent; chemistry through organic, one year of physics and mathematics. (Given at Beaufort.) 6 units. *Barber*

216. Limnology. A study of lakes, ponds, and streams, including their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities living in them. Lectures, field trips, and laboratory work. Usually offered in alternate years. Prerequisites: introductory college biology, chemistry, physics, and Mathematics 31; or permission of instructor. 3 units; 4 units with laboratory. *Livingstone*

224. Vertebrate Zoology. A study of life histories, adaptations, ecology, and classification of vertebrate animals. Prerequisite: Zoology 56. 4 units. *Bailey*

229. Morphogenetic Systems. Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: introductory biology. 3 units. *Gregg*

236. Human Genetics. See course description for Anatomy 236. (Also listed as Anatomy 236, Anthropology 236, and under the Genetics Program.) 3 units. *Buettner-Janusch*

238. Systematic Zoology. The fundamental theory and practice involved in the collection, identification, and classification of animals. Prerequisite: college biology. 4 units. *Bailey*

239. Biogeography. Seminar. Old and new distributional concepts of nimals and plants involving physical geography, geology, paleontology, systematics, volution, population dynamics and dispersal. Prerequisite: permission of the nstructor. 3 units. *Bailey*

240. Chemical Oceanography. Physicochemical properties of seawater. ectures, laboratory work, and field trips. Prerequisite: a year of analytical or hysical chemistry, an introductory course in general of physical oceanography or ermission of the instructor. (Also listed as Chemistry 240.) (Given at Beau-ort.) 6 units. *Baier (Chemistry)*

245. Radiation Biology. Actions of ionizing and excitational radiations on ife processes; biological use of radioactive tracers; nucleonics. Prerequisites: col-ege physics, mathematics, and chemistry. 3 units; 4 units with laboratory. *Fluke*

246. Physical Biology. Physical principles of structure and function in arge biological molecules and aggregates, applications to function at higher evels of organization, and to biological fitness. Prerequisites: college mathematics, hemistry, physics, and one biology course beyond the introductory course, or onsent of instructors. 3 units. *Fluke and Wainwright*

248. Introductory Biochemistry. For description, see Biochemistry 247. Also listed as Biochemistry 247, Botany 248.) 3 units. *Webster (Biochemistry) nd Sage (Biochemistry)*

250. Physiological Ecology of Marine Animals. A study of the physio-ogical responses of marine animals in relation to certain environmental factors nd evolution. Animals representing numerous phyla from various habitats are tudied. (Given at Beaufort.) Prerequisite: a course in physiology. 6 units. *Staff*

252. Comparative Physiology. The physiological mechanisms of animals tudied on a comparative basis. Prerequisite: Zoology 151 or equivalent. 4 units. *chmidt-Nielsen*

254. Fluid Flow and Living Systems. Seminar. Physical principles of low peed flow; applications to locomotion, circulation, dispersal, ventilation, filtra-ion, and heat dissipation. Prerequisites: college physics and Mathematics 31 or quivalent. 3 units. *Vogel*

258. Laboratory and Research Methods. Radioisotope methods, spectro-hotometry, light microscopy, transmission and scanning electron microscopy, -ray diffraction, gel electrophoresis, isolation of cell components, and other nethods. Students may select methods according to their interests and research eeds. Prerequisite: consent of the instructor. Credits to be arranged. 1-4 units. *. Wilbur and Staff*

260. Advanced Cell Biology. Structural and functional organization of ells and their components, emphasizing current research problems and prospects. rerequisites: introductory cell biology or genetics with permission of instructor; ntroductory biochemistry recommended (may be taken concurrently). 3 units. *icklas, K. Wilbur, and Staff*

262. Cytological Materials and Methods. General cytological analysis, vith emphasis on chromosome studies using current optical, cytochemical, and ther experimental techniques. Prerequisite: Zoology 160 or 260 or equivalent may be taken concurrently). 2 units. *Nicklas*

266. Topics in Cell Structure and Function. Advanced discussions o selected problems such as chromosome structure, mitosis and cytological aspect of inheritance and development. Prerequisites: Zoology 160 or 260 or equivalen and permission of the instructor. (Alternates with Zoology 288.) (Also listed a Anatomy 266.) 2 units. *Nicklas and Moses (Anatomy)*

274. Marine Invertebrate Zoology. Structure, functions, and habits o invertebrate animals under normal and experimental conditions. Field trips will b made to study, collect, and classify animals in their natural habitats. Prerequisite college biology (Given at Beaufort.) 6 units. *Staff*

275. Invertebrate Zoology. Lectures, readings, and laboratory work dealin with free-living and parasitic invertebrates. Field trips to freshwater and marin habitats. Not open to students who have had 174 or 274. (Also listed as Zoolog 175L.) Prerequisite: college biology. 4 units. *Bookhout*

276. Comparative and Evolutionary Biochemistry. See course descriptio for Biochemistry 276. (Also listed as Biochemistry 276.) 6 units. *Sullivan*

277. Endocrinology of Marine Animals. Control of growth, regeneration reproduction, metabolism and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. *Hagadorn*

278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) 6 units. *Bookhout*

280. Principles of Genetics. See course description for Botany 280. (Also listed as Botany 180, Botany 280, and under the University Program in Genetics.) 3 units. *Boynton (Botany), Gillham, and Others of the University Program i Genetics*

286. Evolution. Analysis of the processes of adaptation and evolution i individuals, populations, and genetic systems. Prerequisite: genetics or consent o the instructor. (Also listed as Botany 186, Botany 286, Zoology 186, and unde the University Program in Genetics.) Not open to students who have had Zoolog 109 or Botany 240. 3 units. *Antonovics (Botany) and Lundberg*

286L. Evolution. Same course as 286 except laboratory included. 4 units. *Antonovics (Botany), and Lundberg*

288. The Cell in Development and Heredity. See course description for Anatomy 288. (Also listed as Anatomy 288 and under the University Program in Genetics.) 2 units. *Counce (Anatomy), Gillham, and Staff*

295, 296. Seminar. Topics, instructors, and course credits announced each semester. 1-3 units. *Staff*

For Graduates

333. Primate Evolution. See course description for Anatomy 333. (Also listed as Anatomy 333 and Anthropology 333.) 3 units. *Buettner-Janusch*

334. Topics in Physical Anthropology. See course description for Anatomy 334. (Also listed as Anatomy 334 and Anthropology 334.) 3 units. *Buettner-Janusch*

351, 352. Departmental Seminar. A weekly meeting of graduate students and faculty to hear and discuss research reports. 1 unit credit by arrangement. *Staff and Invited Lecturers*

353, 354. Research. To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*

355, 356. Seminar. One or more seminar courses in particular fields are given each semester by various members of the staff. These will be in the fields indicated under Zoology 353, 354. 2 units. *Staff*

360, 361. Tutorials. Students will write essays based on reading of literature. Essays will be discussed and critically evaluated in meetings. 2 units per semester. *Staff*

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of The University Program in Genetics; see announcement in this *Bulletin.*

Marine Laboratory. The following courses are given at Duke University Marine Laboratory, Beaufort, N. C.: 202, Introduction to Comparative Behavior; 203, Marine Ecology; 214, Biological Oceanography; 240, Chemical Oceanography; 250, Physiological Ecology of Marine Animals; 274, Marine Invertebrate Zoology; 276, Comparative and Evolutionary Biochemistry; 277, Endocrinology of Marine Animals; 278, Invertebrate Embryology. Consult Marine Sciences in this *Bulletin* for other offerings at the Duke University Marine Laboratory.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Latin America. Refer to the section Organization for Tropical Studies in this *Bulletin* in the chapter on Special and Cooperative Programs.

Appendix

ADVANCED DEGREES CONFERRED MAY 14, 1972

Master of Arts

Amond, Carl Arthur
Anders, Roger Manifold
Baker, Marion Roscoe
Barnett, Huey D.
Becker, Alice Jeanne
Boren, Susan Hope
Bramlett, David Anthony
Brown, David William
Bryan, Dorothy Anne
Burr, James Hugh
Clark, Robert Louis
Cochran, James Wallace
Collier, Charles Frank
Cope, John Arthur, Jr.
Dixon, Edward Francis, Jr.
Douglass, Robert Bruce
Duncan, Marian Lewis
Dutton, John Coatsworth, Jr.
Dutton, Marilyn Miller
Edmonds, James Albert
Elder, David Terrell
Escott, Paul David
Fairfull, Thomas McDonald
Fisk, Charles L., Jr.
Flaum, Iser Ber
Fletcher, Stephen Wallerich
Flye, Melvyn Wayne
Giberson, Linda
Gibson, Gail McMurray
Gillula, James Walter
Gjertsen, William Russell
Goin, Kennith William
Goldthorp, Patricia
Greiert, Steven Gregory
Hackney, David Leroy
Hall, Jacqueline Brown
Hallett, Patricia Mary
Hannon, Harold Michael
Happel, Stephen Kent
Harkins, Elizabeth Bates
Hartwig, Ingrid U.
Harvey, Cathy Chance
Hastings, Marilyn
Haynes, Edward Sheldon
Highby, Marie Bolduan
Huff, Judith Lynn
Hupf, Robert Edmund
Jacob, Michael William
Jacobson, Roy Steven
Johnson, Maureen McCauley
Karanastasoglou, Thomas A
Keen, Lorra Ann
Keith-Lucas, Timothy
Levine, Sharon Goodman
Lindquist, David Payne
Livesay, James Jefferson, Jr.
Luteyn, James Leonard
Mao, Dorothy Wen-chuan
Martin, John Rutledge
McCredie, Brian
McManis, Charles Rowland
Mentzer, James Gerrard
Monrad, John Raymond
Nelson, Molly Sue
Norris, Bahar Bahrami
Pearson, Diane Lynne
Price, Jane Bostian
Pubantz, Jerret James
Rapoport, Sheldon J.
Roj, William Henry
Rosenblum, Joseph
Schirm, David Craig
Schneider, Tracy Whittaker
Seaks, Terry Gilpin
Seiler, Dennis Lee
Sheer, Alain Herbert
Sipe, Keith Raymond
Skillen, James William
Smith, Walter Preston
Spindel, Donna Jane
Strobel, Marian Elizabeth
Tambunlertchai, Somak
Tillman, Patricia Ann
Vogel, Ronald John
White, Martin Patrick, Jr.
Wotherspoon, William Allen
Wright, Edith Carolyn
Wrocklage, Frances Eileen

Master of Arts in Teaching

Badenhoop, Judith Evelyn
Cheney, Jean Balderson
Cogswell, Mary Jo Griffin
Farrar, Amelia Bancroft
Goodson, Barbara Ann
Sands, Edward Van Volkenburgh
Scrivner, Thomas William
Shih, Janet Chin
Suggs, Linda Sears
Williams, Harriet P.

Master of Education

Allen, Judith E.
Andrews, Ernest Earle
Bobo, Judith Koon
Campbell, David A.
Campbell, Diane Collins
Coggins, Toni Paulette
Coleman, Bonita Louise
Darden, James Bizzell, III
Duvall, Diann Lovett
Giddings, Wendy Jane
Hart, Martha Burns
Henderson, Betty Lou
Johnson, Blair Newcomb
Keyser, Janet Wells
McPherson, Jane Harmeling
O'Connor, Richard Dennis
Pearlman, Elaine Friedman
Powers, Charlotte Anne
Rice, Angie Hoffpauir
SanMiguel, Linda
Schwartz, Patricia A.
Singer, Carol Jane
Tanner, Lynn Wright
TePaske, Neomi Lynn
Timmerman, Frederick Whiting, Jr.
Tsui, Yuen Lung Chu
Ward, Eleanor Ann
Williams, Kathleen Dianne

Master of Science

Baird, Russell James
Beattie, John Jerome, Jr.
Craik, Rebecca Lynn
Dakermandji, George
De Scherer, Joanne
Dickerson, William R.
Gresham, Charles Arthur
Hagaman, Barbara Diane
Honan, Linda Lee
Kane, Nancy Ann
Kuo, Andrew Wen-Lung
Lee, Fred Chai-Yan
Liu, Sien-Chang Charles
Mercier, Omer L.
Ohri, Anil Kumar
Parikh, Rajeshchandra Nareshchandra
Radwan, Abobakr M.
Roy, Judith Ann
Shaw, Michael B.
Shepherd, George Woodthorpe, III
Shiau, Chin-Chih
Smith, Leslie David
Torr, Pamela Anne
Upson, M. Jane
Westervelt, Van Dien
White, King Preston, Jr.

Master of Business Administration

Capoor, Ram
Cohen, Henricus Daniel
Dominguez, Jorge Manuel Rogelio
Elkins, T. A.
Ferebee, John Spencer, Jr.
Hoggard, John Hyde
Lehman, William Martin
Little, Prescott Manning, Jr.
Loughridge, Dennis Wayne
MacQueen, Bruce Robert
Moser, Ronald Bryant
Raper, Julian Robert, III

Master of Hospital Administration

Athans, Marion Scott
Badger, Theodore Jenkins, Jr.
Bellinger, James Clarence
Chalek, Herbert Alan
Donnelly, Thomas Brian
Eckel, Paul Bryan
Goldman, Thomas Marvin
Haskins, Larry Wayne
Kennedy, Thomas D., III
Komiske, Bruce King
Reising, John Howard
Rick, Kevin Guerre
Scopac, Paul Anthony
Shepherd, Stephen Robert
Smith, Michael Morgan
Smith, William Randolph
Zimmerman, Barklie Waters

Master of Science in Nursing

Bowling, Elizabeth Barfield
Bunké, Sister Erika, S. C.
Dubbé, Marsha Gayle Avner
Greenberg, Barbara Marcia
Griggs, Winona Pauline
Hammett, Louanne Lewis
Healy, Sister Kathryn
Hesse, Kathryn Anne
Ingram, Linda Harrison
Morgan, Evelyn Davis
O'Brien, MaryJoan
Rowell, Mary Rose
Schwab, Sister Marilyn, O.S.B.
Shields, Eldonna Marie
Swift, Billie Catherine

Doctor of Education

Arrants, Glen Clyburn (A.B., Catawba College; M.Ed., University of North Carolina). *Education.* Dissertation: "An Individually Prescribed Instructional Program Using Behavioral Objectives with Primary Educable Mentally Retarded Children"

Bailey, Franklin Boyd (B.S., Wake Forest University; M.Ed., East Carolina University). *Education.* Dissertation: "The Systems Approach to Public Elementary and Secondary School Construction"

Baker, George A., III (A.B., Presbyterian College; M.Ed., Shippensburg State College). *Education.* Dissertation: "A Systems Approach to Organization Development: Identifying and Achieving Consensus on the Goals of a Community College Dedicated to Student Learning"

Barker, Fitzhugh Lee, Jr. (A.B., Wake Forest University; M.S., North Carolina State University). *Education.* Dissertation: "Attitudes Toward Student Unrest on the Part of Students, Teachers, and Administrators in Selected High Schools of North Carolina"

Barton, Thomas Everett, Jr. (B.S., Clemson University; M.A., George Peabody College). *Education.* Dissertation: "A Plan for Comprehensive Community College Education in Puerto Rico" (Co-author, Donnie Casper Garrison)

Buie, James Allen (A.B., Elon College; M.A., Western Carolina University). *Education.* Dissertation: "An Investigation and Analysis of Selected Characteristics of Students Who Withdrew from the Goldsboro City School System to Attend Independent Schools"

Cummings, James Bryce (A.B., M.A., East Carolina University). *Education.* Dissertation: "Lease-purchase Financing for the Erection or Renovation of Public School Facilities in North Carolina"

De Lucia, Shirley W. (A.B., Iowa Wesleyan College; M.Ed., Duke University). *Education.* Dissertation: "Development of Review Packages for Improved Understanding and Use of Decimal Ouantities by Upper Elementary Students"

Garrison, Donnie Casper (A.B., M.A., Furman University). *Education.* Dissertation: "A plan for Comprehensive Community College Education in Puerto Rico" (Co-author, Thomas Everett Barton, Jr.)

Greene, Annette (B.S., Appalachian State University; M.A., East Carolina University). *Education.* Dissertation: "Opinions of Selected Publics Toward Planning and Management Practices and Programmed Changes in North Carolina Public Schools"

Hockaday, Johnas Fulton (B.S., Atlantic Christian College; M.Ed., East Carolina University). *Education.* Dissertation: "The Attitudes of Selected North Carolina Community College Personnel Toward the North Carolina Association of Educators"

Jackson, Roger Hiatt (B.S., M.A., Appalachian State University). *Education.* Dissertation: "The Development of an Organizational Model and Strategies for Implementation of a Regional Education Agency for the State of North Carolina"

Ketner, William Don (B.S., Wake Forest University; M.A., East Carolina University). *Education.* Dissertation: "Multimedia Individualized Instruction in Teaching Adults New Automated Systems in the U. S. Army Materiel Command"

Lee, Frederick Jackson, Jr. (A.B., M.A.T., Duke University). *Education.* Dissertation: "Prediction of Student Success at the North Carolina Advancement School"

Lilley, Leonard David, Jr. (B.S., M.Ed., East Carolina University). *Education.* Dissertation: "A Follow-up Study of 1968-69 Graduates of the Adult Basic Education Program in North Carolina"

Martin, William Arthur (B.S., M.Ed., North Carolina State University). *Education*. Dissertation: "A Study of the Decision-making Behavior of Administrators with Relation to the Organizational Structure of North Carolina Public Community Colleges"

Parker, Joseph Samuel, Jr. (B.S., M.S., North Carolina Central University). *Education*. Dissertation: "Development of a Textbook and Learning Operations in Life Science for Elementary Education Majors at North Carolina Central University"

Spencer, Thomas Darrell (B.S., M.A., North Carolina State University). *Education*. Dissertation: "Public Law 874, Title I, Section C: Some Implications for Public School Finance in North Carolina"

Doctor of Philosophy

Althaus, Paul Guenther (A.B., Gettysburg College). *Economics*. Dissertation: "Fiscal and Monetary Policy in Economic Growth"

Arispe, Nelson Jose Arispe (Licenciado, Universidad Central de Venezuela). *Physiology*. Dissertation: "The Cable Properties of a Non-linear Axon"

Armstrong, Robert Nicely (B.S.M.E., Duke University; M.S.M.E., University of Pennsylvania). *Mechanical Engineering*. Dissertation: "A Microstructural Model for the Mechanical Behavior of an Oriented Semi-crystalline Polymer Fiber"

Atteridge, Thomas, III (A.B., Dartmouth College; M.A., Duke University). *English*. Dissertation: "Knavery and Artistry Sublime: Swift's *Examiner*, 1710-11"

Audibert, Jean Marie Emmanuel (Engineer Diploma, Ecole Nationale Superieure d'Arts et Metiers). *Civil Engineering*. Dissertation: "Prediction and Measurement of Strain Fields in Soils"

Awadalla, Nabil G. (B.Sc., Cairo University; M.S., Duke University). *Civil Engineering*. Dissertation: "Stability Problems of Two Ocean Structures: Moored Ships and Mining Pipelines"

Berlin, Barry Peter (A.B., Brandeis University; M.A., Duke University). *Economics*. Dissertation: "An Economic Analysis of Foundation Grants"

Berry, Alice Fiola (A.B. M.A., University of Minnesota). *Romance Languages*. Dissertation: "Rabelais: *Homo Logos*"

Bigner, Darell Doty (B.S., University of Georgia; M.D., Duke University). *Microbiology*. Dissertation: "Canine Brain Tumors Induced with Schmidt-Ruppin Rous Sarcoma Virus: Virus Concentration, Natural History, Morphology, and Virus-Cell Relationships"

Bird, Keith William, Jr. (A.B., Alma College; M.A., Duke University). *History*. Dissertation: "Officers and Republic: The German Navy and Politics"

Boggs, Wade Hamilton, III (A.B., Princeton University; M.A., Duke University). *History*. Dissertation: "State-supported Higher Education for Blacks in North Carolina, 1877-1945"

Boulton, Wayne Granberry (A.B., Lafayette College; M.Div., McCormick Theological Seminary; M.A., Duke University). *Religion*. Dissertation: "Ethics and Vision: The Role of Myth in the Thought of Reinhold Niebuhr"

Branch, Eleanor Flanagan (A.B., Middlebury College; M.A., Duke University). *Pathology*. Dissertation: "Morphological Aspects of Changing Capillary-parenchymal Relationships in the Maturing Chick Spinal Cord"

Breit, Frederick Joseph (A.B., Roosevelt University; M.A., Duke University). *History*. Dissertation: "The Bolshevization of the Comintern, 1919-1924"

Brown, George Raymond (B.S., Georgia Institute of Technology). *Physics*. Dissertation: "The Specific Heat of Helium Near the Liquid-gas Critical Point"

Byrne, Donald E., Jr. (A.B., St. Paul Seminary; M.A., Marquette University). *Religion*. Dissertation: "Methodist Itinerant Folklore of the Nineteenth Century with Particular Reference to Autobiography and Biography"

Carey, Roger Neill (B.S., University of Richmond). *Chemistry*. Dissertation: "Part I. Labtran, A Language and System for Programming Chemical Experiments. Part II. Polarographic Behavior of Some Group IVB Derivatives of Naphthalene"

Cassel, Thomas Zion (A.B., University of Miami). *Psychology*. Dissertation: "Stimulus Representation in the Somesthetic System: Receptive Field Dynamics, Across Fiber Patterns and Behavioral Specialization"

Clifford, Miriam Wittelle (A.B., Miami University; M.S., University of Illinois). *Education*. Dissertation: "Differential Aspects of Language Skill in Deaf and Hearing Children, with Attention to Social Class Differences"

Coad, Bruce Eric (A.B., Wittenberg University; M.A., University of North Carolina). *Education*. Dissertation: "The Initiation Myth: A Textbook for College Freshmen Employing a Structural Approach to the Study of American Short Fiction"

Colford, Elizabeth Esperanca (A.B., Smith College; M.A., Duke University). *Romance Languages*. Dissertation: "The Themes of Love and Death in the Poetry of Pierre Jean Jouve"

Conde, Louis Francis (B.S., Cornell University; M.A., Duke University) *Botany*. Dissertation: "Anatomical Comparisons of Some Cylindro- and Platyopuntias"

Cook, Gordon Southworth, Jr. (A.B., Columbia University; M.Sc., London School of Economics; M.A., Duke University). *History*. Dissertation: "Petr la. Chaadaev and the Rise of Russian Cultural Criticism, 1800-1830"

Crosthwaite, Jane Freeman (A.B., Wake Forest University; M.A., Duke University). *Religion*. Dissertation: "'Confident Despair': Some Aspects of Theology Implicit in the Poetry of Emily Dickinson"

DeGraaff, Robert Mark (A.B., Calvin College; M.A., Miami University). *English*. Dissertation: "The 'Implied Author': A Study of Point of View in Selected Novels by George Meredith"

Dendy, John Oliver (A.B., Royal Military College; M.A., Carleton University). *History*. Dissertation: "Frederick Haldimand and the Defence of Canada, 1778-1784"

Dillon, Bert (A.B., University of Colorado; M.A., Columbia University). *English*.. Dissertation: "A Dictionary of Personal, Mythological, Allegorical, and Astrological Proper Names and Allusions in the Works of Geoffrey Chaucer"

Dunaway, John Marson (A.B., Emory University; M.A., Duke University) *Romance Languages*. Dissertation: "The Metamorphoses of the Self: The Mystic, the Sensualist, and the Artist in the Works of Julien Green"

Eichler, Margrit (M.A., Duke University). *Sociology*. Dissertation: "Charismatic and Ideological Leadership in Secular and Religious Millenarian Movements"

Embry, Charles Roscoe (A.B., Louisiana Polytechnic Institute; M.A., Louisiana State University). *Political Science*. Dissertation: "A Critical Examination of the Thought of Karl Popper"

Evans, Vincent Jeffery (B.S., Loyola College; M.A., Duke University). *Economics*. Dissertation: "An Analysis of the Demand for Professors for the State System of Higher Education of North Carolina: 1970-2000"

Feng, Yun-Ming (B.S.E.E., National Taiwan University; M.S., Duke University). *Electrical Engineering*. Dissertation: "Very-high-frequency DC-to-DC Conversion and Regulation"

Friedman, George Stephen (A.B., Temple University; M.A., Duke University). *English*. Dissertation: "Reconstruction and Redemption in Selected American Novels, 1878-1915"

Gerstle, Francis Peter, Jr., (A.B., St. Joseph's College; B.S., M.S., Massachusetts Institute of Technology). *Mechanical Engineering*. Dissertation: "Deformation of Dry Steel Surfaces During High-velocity Sliding Contact"

Gilpin, Robert Peyton (A.B., Princeton University; M.A., Duke University). *History*. Dissertation: "Christian Names Versus *Fuhrerpolitik*: Anglo-German Relations 1933-1935"

Goodman, William Richard, Jr. (A.B., Washington and Lee University; B.D., Union Theological Seminary). *Religion*. Dissertation: "A Study of I Esdras 3:1-5:6"

Gormus, Bobby Joe (B.S., University of Richmond). *Biochemistry*. Dissertation: "Studies on Capsular Polysaccharides Obtained from *Kelbsiella*e"

Grunes, Rodney Arthur (A.B., Drew University; M.A., Duke University). *Political Science*, Dissertation: "The Warren Court and the Problem of Obscenity"

Hagglund, Lee Oliver (A.B., Gustavus Adolphus College). *Mathematics*. Dissertation· "Existence of Proper Topologies in Commutative Rings"

Hallman, David Alvin (A.B., Vanderbilt University; M.A., Memphis State University). *English*. Dissertation: "Donald Davidson: The Development of His Poetry"

Hardekopf, Robert Allen (B.S., Auburn University). *Physics*. Dissertation: "Neutron Polarization from the D(d,n)^{3}He Reaction and Analyzing Powers of T(p,d)D and T(p,p)T"

Harrington, Jonathan Edward (A.B., Harvard College; A.B., University of Cambridge). *Zoology*. Dissertation: "Olfactory Communication in *Lemur Fulvus*"

Hass, Rolland Glen (B.S., Georgia Institute of Technology). *Psychology*. Dissertation: "Resisting Persuasion and Examining Message Content: The Effects of Source Credibility and Recipient Commitment on Counterargument Production"

Hattler, Brack G., Jr. (A.B., Duke University; M.D., Cornell University). *Microbiology*. Dissertation: "A Study of the Mixed Lymphocyte Culture Assay in the Dog and Factors that Modify it Following Allografting"

Hawthorne, James William (A.B., University of Victoria). *Psychology*. Dissertation: "Th Influence of the Set and Dependence of the Data Collector on the Experimenter Bia Effect"

Heitzenrater, Richard Paul (A.B., B.D., Duke University). *Religion*. Dissertation: "Joh Wesley and the Oxford Methodists, 1725-35"

Hillman, Elizabeth Ann (A.B., Russell Sage College). *Microbiology*. Dissertation: "Respons of the Liver to the Avian Leukosis Agent, MC29: A Morphological Study"

Honhart, Michael William (A.B., Carleton College; M.A., Duke University). *History*. Dissertation: "The Incomplete Revolution: The Social Democrats' Failure to Transform the German Economy, 1918-1920"

Hopkins, Edwin Elwell (A.B., University of Maryland). *Philosophy*. Dissertation: "Wilfrid Sellars' Analysis of Physical Modality: In Search of an Argument"

Howard, David Allyn (A.B., Gordon College; M.A., Duke University). *History* Dissertation: "The Royal Indian Hospital of Mexico City"

Huston, James Stafford, Jr. (B.S., University of Michigan). *Biochemistry*. Dissertation: "Structural Studies of the Fd Fragment and its Domains from Rabbit Immunoglobulin G"

Jauregui, Hugo Osvaldo (M.D., College of Medicine of Buenos Aires). *Pathology*. Dissertation: "Cell Surface Studies on Parasynchronous and Asynchronous Populations Hela Cells"

Jensen, Walter, Jr. (A.B., University of Colorado; J.D., M.B.A., Indiana University). *Political Science*. Dissertation: "Diplomatic and Consular Immunities in Great Britain: Doctrine and Diplomatic Practice"

Johnson, Paul Richard (A.B., Bethel College; M.Div., Bethel Seminary). *Religion*. Dissertation: "The Search for the 'Human' in Recent Ethics: An Analysis of Recent Ecumenical Ethics from the Perspective of the Sociology of Knowledge"

Jones, Douglas Jerry (B.S., M.Ed., University of Cincinnati). *Education*. Dissertation: "A Study of Variables Related to the Achievement of Underachieving Boys in an Open Education Environment"

Jotisankasa, Vinita (M.D., Mahidol University). *Microbiology*. Dissertation: "*In Vitro* and *In Vivo* Study of Some of the Known Pathogenic and Unknown Pathogenic Species of the Genus *Phialophora*"

Kauffman, Sidney Lloyd, Jr. (B.S.E.E., M.S., Duke University). *Electrical Engineering*. Dissertation: "Study of a Non-stationary Spacecraft Data Channel"

Kilham, Peter (A.B., Dartmouth College). *Zoology*. Dissertation: "Biogeochemistry of African Lakes and Rivers"

Killion, Howard Ray (A.B., Westmont College; M.A., Claremont Graduate School). *History*. Dissertation: "The Suffren Expedition: French Operations in India During the War of American Independence"

Koenning, Alton Ray (A.B., Texas Lutheran College; B.D., Evangelical Lutheran Theology Seminary). *Religion*. Dissertation: "Henkel Press: A Force for Conservative Lutheran Theology in Pre-Civil War Southeastern America"

Ku, Peter Chia-Shan (A.B., Chung-Hsing University; M.A., University of Minnesota; M.A., East Carolina University). *Education*. Dissertation: "Master Plan for Community Colleges in the Republic of China"

Laine, Amos Lee (A.B., Randolph-Macon College; M.A., Duke University). *History*. Dissertation: "John Rastell: An Active Citizen of the English Commonwealth"

Lamaze, George Paul (A.B., Harvard University). *Physics*. Dissertation: "A Study of the Gamma Decay of Excited Levels of ^{51}Ti"

Lawson, Dewey Tull (A.B., Harvard University). *Physics*. Dissertation: "Phonon Scattering by Isolated Isotopic Impurities in Single Crystals of Helium"

Lebedda, James David (A.B., Washington and Jefferson College). *Chemistry*. Dissertation: "The Electronic Structure and Spectra of Diethyedithophosphate Complexes"

LeClair, Thomas Edmund (A.B., Boston College; M.A., University of Vermont). *English*. Dissertation: "Final Words: Death and Comedy in the Fiction of Donleavy, Hawkes, Barth, Vonnegut, and Percy"

Leversee, Gordon Jepson, Jr. (A.B., Dartmouth College) *Zoology*. Dissertation: "Organization and Synthesis of the Axial Skeleton of *Leptogorgia Virgulata*"

Locke, Elizabeth Hughes (A.B., Duke University; M.A., University of North Carolina). *English*. Dissertation: "Anthony Trollope and the Novel of Manners"

Loken, Mark Keith (A.B., Concordia College; M.A., University of Calgary). *Economics*. Dissertation: "The Impact of Effective Commercial Policy on Patterns of Canadian Exports"

Lothstein, Leslie Martin (A.B., Queens College). *Psychology*. Dissertation: "Personal Space in Assault-prone Male Adolescent Prisoners"

Macleod, Roderick Charles (A.B., University of Alberta; M.A., Queen's University). *History*. Dissertation: "The North-West Mounted Police 1873-1905: Law Enforcement and the Social Order in the Canadian North-West"

Malone, John C., Jr. (A.B., State University of New York). *Psychology*. Dissertation: "Contrast Effects in Maintained Generalization Gradients"

Mancusi, Joseph Leonard (B.S., Iona College; M.A., Iowa State University). *Psychology*. Dissertation: "Vasomotor Conditioning of Finger Pulse Volume Using Nonpainful Aversive Visual Stimuli"

McNab, James Potter (A.B., Edinburgh University; M.A., Duke University). *Romance Languages*. Dissertation: "The Personal Mythology of Jean Cocteau: The Emergence of the Poet, 1920-1930"

Meathenia, Jack (B.S., M.A., West Texas State University) *English*. Dissertation: "A Study of the Functional Aspects of Humor in the Works of Nathaniel Hawthorne"

Meier, Carl Wagner (A.B., Lafayette College; B.D., Yale University). *Philosophy*. Dissertation: "Kant's Second Analogy: A Reconstruction"

Melton, Hewlett Edsel, Jr. (B.E.E., M.S., Auburn University). *Biomedical Engineering*. Dissertation: "Electronic Focal Scanning for Improved Resolution in Ultrasound Imaging"

Menning, Bruce William (A.B., St. John's University; M.A., Duke University). *History*. Dissertation: "The Socialization of the Don Cossack Host Prior to the Reign of Nicholas I"

Molina, Gerardo A. (B.S., University of Puerto Rico; M.S., University of Pennsylvania). *Chemistry*. Dissertation: "Biosynthesis of the Mesembrine Alkaloids: Synthesis and Conformational Analysis of Simple *cis*-Octahydroindoles and Similar Systems"

Moreland, Richard Scott (A.B., Trinity College). *Economics*. Dissertation. "Property Rights, Externalities, and Policy"

Moss, Beverly Jean (A.B., Duke University). *Romance Languages*. Dissertation: "Various Contradictory Aspects of the Love Poetry of Leconte De Lisle"

Mueller, Karl Hugo, Jr. (A.B., Rice University). *Physics*. Dissertation: "Thermal Pulses and Second Sound in Hexagonal Close-Packed Helium-4"

Nelson, Ronald Orville (B.S., Florida State University). *Physics*. Dissertation: "A Study of Inelastic Effects in Nucleon Pickup Reactions on ^{25}Mg and the Structure of ^{24}Na and ^{24}Mg"

Ness, Gary Clifford (B.S., Iowa State University; M.A., Duke University). *History*. Dissertation: "The States' Rights Democratic Movement of 1948"

Niemann, Thomas Charles (B.S., University of Wisconsin; M.A., Duke University). *English*. Dissertation: "*Pearl* and the Medieval Christian Doctrine of Salvation"

Olivier, Thomas Joseph (B.S., Tulane University; M.A., Duke University). *Anthropology*. Dissertation: "Microevolution in Kenya Baboons"

Painter, Richard Grant (B.S., University of Florida). *Biochemistry*. Dissertation: "The Relative Contributions of Heavy and Light Chains to Antibody Activity"

Patrick, Robert L. (A.B., Temple University). *Biochemistry*. Dissertation: "Regulation of Catecholamine Synthesis and Storage in the Adrenal Medulla"

Pelkonen, John Peter (A.B., B.D., Wittenberg College). *Religion*. Dissertation: "Martin Luther's Theology of Prayer, Its Systematic Structure and Its Significance for Michael Agricola, the Reformer of Finland"

Pisciottoli, Louis Francis (A.B., Boston College). *Economics*. Dissertation: "Allocational and Distributional Effects of Conscription"

Polacco, Joseph Carmine (B.S., Cornell University). *Biochemistry*. Dissertation: "The *leu*-3 Cistron as a Genetic Regulatory Element for the Leucine Biosynthetic Enzymes of Neurospora"

Polacco, Mary Laura Schaeffer (A.B., Swarthmore College). *Biochemistry*. Dissertation: "Fatty Acid Metabolism in a Biotin Auxotroph of *Escherichia Coli K* 12"

Porter, Pamela Northington (A.B., University of Kentucky). *Physiology*. Dissertation: "Control of Carbohydrate Metabolism in Tetrahymena: A Study of Aspartic Transaminase, Tyrosine Transaminase, Glutamic Dehydrogenase and Lactic Dehydrogenase"

Potter, Joyce Elizabeth (A.B., Carson Newman College; M.A., University of Tennessee). *English*. Dissertation: "Chaucer's Use of the Pagan God Jove"

Pratt, Lindsay Page, Jr. (A.B., Wake Forest University; M Div., Crozer Theological Seminary). *Religion*. Dissertation: "The Religious Life Styles of the Members of Two North Carolina Baptist Churches"

Rivin, Bernard David (B.M.E., M.M.E., New York University). *Biomedical Engineering.* Dissertation: "Parameters in Multiphase Dialysis of Lipid Soluble Substances"

Robbins, David Alvin (A.B., Dartmouth College; M.A., Bucknell University). *Mathematics.* Dissertation: "Tensor Products and Representations of Banach Modules"

Robertson, James Michael (A.B., Taylor University; M.A., Duke University). *English.* Dissertation: "Byron's *Don Juan* and the Aristocratic Tradition"

Rowe, Elizabeth Snow (A.B., Duke University). *Biochemistry.* Dissertation: "Dissociation and Denaturation Equilibria of a Homogeneous Fab Fragment"

Rubin, Byron Herbert (A.B., Reed College). *Chemistry.* Dissertation: "The Crystal and Molecular Structure of Trigonal Tris(diphenyltriazene) Cobalt(III)"

Sanders, Richard W. (A.B., Ursinus College; M.A., Duke University) *History.* Dissertation: "The Labor Policies of the French Radical Party, 1901-1909"

Scarborough, Milton Ray (A.B., University of Mississippi; B.D., New Orleans Baptist Theological Seminary). *Religion.* Dissertation: "Erik Erikson's Anthropology and Its Implications for Epistemology"

Schneider, Joseph Leondar (A.B., Tufts University; M.A., Duke University). *English.* Dissertation: "W. B. Yeats and the Theatre of Intellectual Reformation"

Scott, Robert Taylor (B.S., University of Virginia; B.D., Virginia Theological Seminary; Th.M., Duke University). *Religion.* Dissertation: "Odysseus, Aeneas, and Abraham: Three Archetypes of Personal Identity in Western Thought"

Secrest, Andrew McDowd (A.B., M.A., Duke University). *History.* Dissertation: "In Black and White: Press Opinion and Race Relations in South Carolina, 1954-1964"

Shields, Jerry Ashburn (A.B., M.A., University of North Carolina; M.A., Duke University). *English.* Dissertation: "The Divided Mind of Robinson Jeffers"

Sites, William Horace (A.B., Catawaba College; M.F., Duke University). *Forestry.* Dissertation: "The Infection Biology of Urnula Craterium (Schw.) Fr.

Snow, Thomas Russell (B.S., Carnegie-Mellon University). *Physics.* Dissertation: "Three Body Cross Sections in K p Interactions Near 1670 Mev"

Spalek, George (B.S., St. Procopus College; M.S., University of Notre Dame). *Physics.* Dissertation: "Neutron Polarization from the D(d,n)^{3}He and ^{9}Be(d,n)^{10}B Reactions"

Sparling, Russell Paul (A.B., Arlington State College; M.A., Duke University) *English.* Dissertation: "A Study of Nathaniel Hawthorne's Skeptical Meliorism"

Stein, Marshall David (A.B., Brooklyn College). *Microbiology.* Dissertation: "Studies on the Structure of *Lens Culinaris* Hemagglutinins and Their Reaction with Sugars, Erythrocytes and Lymphocytes"

Sweets, John Frank (A.B., Florida State University; M.A., Duke University). *History.* Dissertation: "The *Mouvements Unis de la Resistance* (M. U. R.): A Study of Noncommunist Resistance Movements in France, 1940-1944"

Taylor, Lewis Jerome, Jr. (B.S., United States Naval Academy; B.D., Seabury-Western Theological Seminary). *Religion.* Dissertation: "The Becoming of the Self in the Writings of Walter Percy: A Kierkegaardian Analysis"

Thomson, Thomas John (A.B., University of Virginia; M.A., Duke University). *History.* Dissertation: "Boris Stürmer and the Imperial Russian Government: February 2-November 22, 1916"

Thursby, Gene Robert (A.B., B.D., Oberlin College). *Religion.* Dissertation: "Aspects of Hindu-Muslim Relations in British India: A Study of Arya Samaj Activities, Government of India Policies, and Communal Conflict in the Period 1923-1928"

Tonzetich, John (B.Sc., University of British Columbia; M.A., Duke University) *Zoology.* Dissertation: "Adaptive Chromosomal Polymorphism in *Drosophila Melanica*"

Touma, André (B.S., University of Damascas; M.S., University of London). *Civil Engineering.* Dissertation: "Design Optimization of Guideways and Dynamic Analysis of Rail Plates for High Speed Transportation"

Townsend, Richard Edward (A.B., University of Redlands; M.A., San Diego State College). *Psychology.* Dissertation: "Human Regional Cerebral Blood Flow During Slow Wave Sleep and Rapid Eye Movement Sleep"

Troy, Joan Brooks (A.B., B.M., Salem College; M.A.T., University of North Carolina). *Education.* Dissertation: "Utilization of Mathematical Modeling Techniques for Predicting Student Performance in Public Elementary Schools"

Vasek, Anna Marie (B.S., Texas Christian University; M.A., Duke University). *Chemistry.* Dissertation: "Crystallite Orientation Distribution Function for Polyethylene Terephthalate"

Walker, Elizabeth Humphrey (A.B., M.A., Emory University). *Romance Languages*. Dissertation: "Jules Romains and Unanimism: The Distant Crowd"

Walters, Ada Jane (A.B., B. Music, Southwestern at Memphis; M.A., Memphis State University). *Education*. Dissertation: "A Comparison of Pupil Achievement and College Success in Two High School Programs: One Modular and One Traditional"

Wappler, Edwin Gould (A.B., Northwestern University; B.D., S.T.M., Seabury-Western Theological Seminary). *Religion*. Dissertation: "Four Anglican Situationists and Their Tradition: A Study in Fletcher, Pike, Robinson, and Rhymes"

Watanabe, Steven Fujio (B.S., Stanford University). *Physics*. Dissertation: "Motional Narrowing of Zeeman Resonances"

Waterbor, Robert Bertram (A.B., Harvard College). *Psychology*. Dissertation: "Experiential Bases of the Sense of Self"

Waterson, Robert M. (B.S., Florida State University). *Biochemistry*. Dissertation: "Structure-function Properties of Crotonase and Its Role in Fatty Acid Oxidation"

Watson, George Lee (A.B., Phillips University; M.A., Duke University). *Political Science*. Dissertation: "The Origins of a Political Party Identification Among Party Activists in Canada and the United States: A Four-City Survey"

Wells, Daniel Arthur (A.B., Union College; M.A., Duke University). *English*. Dissertation: "Evert Duyckinck's *Literary World*, 1847-1853: Its Views and Reviews of American Literature"

Winton, Raymond Sheridan, II (B.S., North Carolina State University). *Physics*. Dissertation: "Observations and Applications of the Lamb Dip in Millimeter-wave Molecular Spectroscopy"

Wyse, Frederick Calhoun (B.S., The Citadel). *Physics*. Dissertation Millimeter and Submillimeter Wave Spectra of the Aluminium Monohalides"

ADVANCED DEGREES CONFERRED SEPTEMBER 1, 1972

Master of Arts

Allum, Philip Dean
Amoss, Clinton Wells
Babin, Edith Hammatt
Ballester, Luis Carlos Peralta
Bargmann, Monika Christiane
Batutis, Michael Joseph, Jr.
Belk, Bonnie Faye
Benson, Thomas David
Blake, Peter Newell
Boe, Virginia Locke
Bowen, Charles Elbert, Jr.
Brandstadter, Dianne Puthoff
Brazauskas, Gabija Eugenija
Brown, Christopher Cardwell
Coates, Dennis Edward
De Maere, Guido M.P.
Dix, Virginia Jill
Brian, Douglas Edwards
Ferguson, Judith Bennatte
Forness, Larry M.
Francis, R. J.
Gardner, Mark L.
Garnjana-Goonchorn, Waroon
Geen, Alfred Francis
Greenberg, Valerie Diana
Grisson, Cynthia Lee
Grode, Stanley E.
Grow, Toni Lynn Flowers
Haase, David Glen
Hackney, Robert Newton
Harding, John David
Harwitz, Paul Edward
Hasting, Susan Carol
Herbst, Paul Michael
Hiwaki, Kensei
Hoffman, Steven Kohn
Huber, Sally Ann
Johnson, Richard M.
Karavitis, George Stephen
Karlson, Ronald Henry
Kennington, Gregory Edmund, Jr.
Klasik, John Arthur
Klein, Carl Beecher
Kuniholm, Bruce Robellet
Moore, Winfred Bobo, Jr.
Ocasio, Blanca
Pejakovich, George
Perna, Michael Lewis
Prout, Gerald Robert
Rauckman, Barbara Seavey
Ross, Jack Meyer, Jr.
Rytina, Nancy F.
Sapp, Robert Holmes
Seamans, Geoffrey L.
Segrest, Mabelle Massey
Singh, Davinder
Skerky, Barbara B.
Spiers, Marjorie M.
Sullivan, Deborah Anne
Thosanguan, Vatchareeya
Wallace, Allen Franklin
Wheeler, Thaddeus Alvin, Jr.

Whitmyre, Gary Keith
Wickley, Mark Anthony
Wimmer, Thomas Lee
Winkle, John Wilson, III
Woods, Susan Elizabeth
Yates, Donald Neal
Ypma, Henricus Johannes Plecheloss

Master of Arts in Teaching

Abbott, Estelle Swindell
Allender, Christine McClenahan
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Dooley, Linda Parrish
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Lewander, Christine Mabel
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Lucas, Guy Boyd
MacPherson, James Craig
McCollough, Mary Lee Rankin
McCrady, William Fauset, III
McLaurin, Michael David
Miller, Evelyn Ellison
Mulholland, Robert William
Murphy, Sister Monica
Palmer, Marilyn Rose
Pasch, Katherine Pollock
Patchak, Richard Henry
Perna, Barbara Britzke
Primmer, Susan Irene
Roberts, Polly Sheffield
Rodgers, Edward Floyd
Russell, Robert Leonard
Schultz, Evelyn Meredith
Scott, Paul Walter
Septon, Lois Flournoy
Shaffer, David James
Shontz, Ralph Tom, Jr.
Smart, Joyce Martin
Smith, Judith York
Smith, Shirley Imojean McCraw
Tucker, James Russell, II
Washburn, Mark Christopher
Zastrow, Herbert Ernest Louis
Ziettlow, Janice L.

Master of Education

Bankhead, Chalmers Christopher, Jr.
Byrd, Ruth Eulane
Cojanis, Helen Michelle
Feifs, Elizabeth Moore
Gorsky, Paul Joshua
Hagan, Robert Douglas
Hamlin, Leon Felton
Kastner, Sister Beverly Ann
Martin, Barbara Ann
Massey, William Preston
Mattox, Merry Beth
Mowry, Barbara Kreowski
Patterson, Lois Anne
Piper, Patricia Ellen
Scott, Sister Anne
Sevald, Barbara Annette Mishalanie
Shields, Elnora Joyner
Snyder, Bonnie Bunce
Thompson, Richard Harvey
Wimmer, Betty-Jo T.

Master of Science

Boonrod, Suchin
Chung, Hsu-Ho
Farlow, John Wayne
Graczyk, Frank Matthew
Grittner, Steven Florian
Kay, Douglass Allan
Lewis, Cynthia Lynn
Liljequist, Laura Ann
Mickey, John Vick
Totti, Noel, III

Master of Science in Nursing

Alexander, Jane Woods
Pochert, Jean Helen
Stoops, Pamela Moore

Doctor of Education

Fowler, David Tayloe (B.S., Davidson College). *Education*. Dissertation: "A Study of Non-public Education in North Carolina at the Elementary and Secondary Level (Grade 1-12): 1966-71"

McDaniel, Lester Robert (B.A., Wake Forest University; M.Ed., University of North Carolina). *Education*. Dissertation: "An Analysis of Central Office Staffing"

Meek, Cleo Marvin (B.A., M.T., Northeastern State College). *Education*. Dissertation: "Attitudes Toward Student Concerns on the Part of Selected Publics"

Westcott, Jacqueline Renee (B.S., Fayetteville State College; M.A., North Carolina Central University). *Education*. Dissertation: "Writing Higher Level Objectives for Two-Year College Instructional Programs"

Doctor of Philosophy

Abernethy, Kenneth Clyde (B.S., University of North Carolina at Charlotte; M.A., Duke University). *Mathematics*. Dissertation: "Characterizations of Generalized Metric Spaces as Open Images of Metric Spaces"

Arndt, Frances Cole (A.B., College of William and Mary; M.A., Duke University). *English*. Dissertation: "*Villette:* Another Turn of the Wheel"

Barkauskas, Anthony Edward (B.A., Whitman College; M.A., Duke University). *Mathematics*. Dissertation: "Analytic and Algebraic Properties of Lommel Polynomials"

Borleske, Stephen Gustav (B.S., College of William and Mary). *Chemistry*. Dissertation: "Synthesis and Properties of Phospholane-, Phospholene- and Phospholecarboxylic Esters and Related Compounds"

Boyce, James Reid (B.S., Florida State University). *Physics*. Dissertation: "Proton Induced Fission Cross Sections of the Uranium Isotopes ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U"

Bruce, Richard Clinton (B.S., University of Washington; M.A., Duke University). *Psychology*. Dissertation: "The Role of Attention in Perceptual Asymmetries"

Buckley, Suzann C. (A.B., Regis College; M.A., Mount Holyoke College). *History*. Dissertation: "Attempts at Imperial Economic Planning, 1887-1919"

Burger, Thomas (M.A., Duke University). *Sociology*. Dissertation: "Max Weber's Theory of Concept Formation. The Methodological Status of the Ideal Type"

Crouse, Barry Wayne (B.S., Rutgers University; M.S., University of Maine). *Forestry*. Dissertation: "*Hibiscus Cannabinus* L., An Annual Fiber Source for Papermaking; Aspects of Its Eocology and Utilization"

Dowda, Robert Ellis (A.B., Birmingham-Southern College; B.D., Th.M., Duke University). *Religion*. Dissertation: "The Cleansing of The Temple in The Synoptic Gospels

Duke, Charles Richard (B.Ed., Plymouth State College; M.A., Middlebury College). *Education*. Dissertation: "Creative Expression and Drama in Education"

Farthing, James David (B.A., Oklahoma Baptist University; M.A., Duke University). *History*. Dissertation: "The House of Cards: The British Search for European Settlement, 1935-1938"

Fehrenbach, Paul Kent (A.B., University of Wisconsin). *Psychology*. Dissertation: "Personality as a Factor in Reported Post-Retirement Anxiety Among Professionals"

Fels, Allan (B.Ec., LL.B., University of Western Australia). *Economics*. Dissertation: "The British Prices and Incomes Board: The NBPI as an Instrument of Incomes Policy Administration"

Fisher, Milton (A.B., University of California; M.S., Washington University). *Psychology*. Dissertation: "Processing Dichotic Stimuli: Latency Measures vs. Order of Report"

Foote, Robert Stephen (B.S., Morris Harvey College; M.A., Duke University). *Chemistry*. Dissertation: "Condensations of α-Lithiohydrazones"

Fox, Martin Dale (B.E.E., Cornell University). *Biomedical Engineering*. Dissertation: "Corrections of Aberrations in Long Wavelength Holography"

Fratcher, Nancy Jean (B.S., Lawrence Unversity; M.A., Duke University). *Chemistry*. Dissertation: "Chemistry of 2,3-Bis(Dimethylamino)-5,5-Bis-(Trifluoromethyl)-1,4,2,3-Diazadiborolidine"

Gatz, Margaret Jean (B.A., Southwestern at Memphis). *Psychology*. Dissertation: "Graphic Representation of Solid Objects in Young Children"

Goldner, Marcia Monahan (B.A., Kansas State University). *Physiology*. Dissertation: "End-Plate Currents in Frog Skeletal Muscle: Alteration of Currents by a Reversible Anticholinesterase"

Gonzalez-Buscan, Valois Carmelo (Lic., Universidad Central de Venezuela). *Botany.* Dissertation: "The Ecology of *Hexastylis Arifolia*, an Evergreen Herb in the North Carolina Deciduous Forest"

Gorbet, Frederick William (B.A., University of Toronto). *Economics.* Dissertation: "Formula Flexibility and the Performance of the Canadian Economy: Simulation Study Using the RDX2 Econometric Model"

Graham, David Martin (B.A., American International College; M.A., Duke University). *Chemistry.* Dissertation: "Bis(Trimethylstlyl)Amino Substituted Aminoboranes. I. Preparations and Reactions. II. B-NR_2 Rotational Barriers"

Greenwald, Stephen Mark, Sr. (B.A., Bellarmine-Ursuline College). *Botany.* Dissertation: "Some Environmental Effects on the Growth and Monoterpene Production of *Pinus Taeda* L. and *Ocimum Basilicum* L.

Grimes, Terrence Layne (B.A., Yale University; M.A., Duke University). *English.* Dissertation: "The Relation of Style and Imagination in Meredith's Novels, 1876-1895"

Haulk, Charles Jakie (B.S., North Carolina State University; M.A., Duke University). *Economics.* Dissertation: "Growth and Employment in a Labor-Surplus Economy"

High, Sydney Houston (B.A., Texas Christian University). *Economics.* Dissertation: "Changes in Occupational Wage Differentials in the United States: 1940-1960"

Hodel, Margaret Jones (A.B., Vassar College). *Mathematics.* Dissertation: "Enumeration of Certain Sequences"

House, Virgil Dwight, Jr. (B.A., Carleton College; M.A., Duke University). *Mathematics.* Dissertation: "Products of Generalized Countably Compact Spaces"

Hower, John Franklin, Jr. (B.A., Franklin and Marshall College). *Chemistry.* Dissertation: "Spin Label Investigations of Ion Exchange Resins, the Enzyme Bovine Carbonic Anhydrase and the Cellular Membrane of Ascites Tumor Cells"

Johnson, Dennis William (B.A., Carleton College; M.A., Duke University). *Political Science.* Dissertation: "Friend of the Court: The United States Department of Justice as *Amicus Curiae* in Civil Rights Cases Before the Supreme Court, 1947-1971"

Johnston, John Franklin (B.A., Northwestern University). *Economics.* Dissertation: "Toward a Positive Theory of Redistributional Public Expenditures"

Kingsley, David Charles (B.A., DePauw University; M.A.T., Duke University. *Education.* Dissertation: "Development and Scoring of a Set of Scales for the Measurement of Teacher Attitudes"

Larkin, John Eliot, Jr. (A.B., Harvard College). *English.* Dissertation: "The Theory and Methods of Criticism in Coleridge and Carlyle"

Lohman, William John, Jr. (A.B., Davidson College; M.A., Duke University). *English.* Dissertation: "Kipling's Experience and Artistic Rendering of Culture Shock"

Madden, Janice Fanning (B.A., University of Denver; M.A., University of Colorado). *Economics.* Dissertation: "The Economics of Sex Discrimination"

Marcus, Carol J. (B.S., Cornell University). *Biochemistry.* Dissertation: "The Catalytic and Allosteric Properties of Bovine Hepatic Fructose 1,6-Diphosphatase"

Martin, Joseph Bacon, III (B.A., Davidson College; M.A., University of Minnesota). *English.* Dissertation: The Medieval Ceyx and Alcyone: Ovid's *Metamorphoses* XI, 407-750, and Chaucer's *Book of the Duchess*"

Martin, Ned Harold (A.B., Denison University). *Chemistry.* Dissertation: "Biosynthetic Studies of the Mesembrine Alkaloids"

Matthews, Charles Odell (A.B., Davidson College; M.A.T., Harvard College). *Education.* Dissertation: "The Effect of Identification with the Technology of Society on the Identity Crisis of College Males as Postulated by Erik Erikson"

McHale, Philip Augustus (B.S., University of Arizona). *Physiology.* Dissertation. "Left Ventricular Wall Stress: A Technique for Direct Measurement and a Comparison with Values Estimated from Several Geometric Models"

Menefee, Andrea Cowles (B.A., Mills College; M.A., Duke University). *Anthropology.* Dissertation: "South Indians in Delhi: Voluntary Associations and Social Networks"

Middlebrook, John Leslie (B.S., Pacific University). *Chemistry.* Dissertation: "Biophysical and Biochemical Studies of Bacteriophage 12.

Miller, June Lancaster (B.A., Longwood College). *Microbiology.* Dissertation: "Characterization of Monkey Antibodies Made in Response to Papain-Solubilized Human Spleen Antigens"

Miller, Robert David (B.S., Davidson College). *Biochemistry.* Dissertation: "A Study of the Changes in Histones During Evolution and Development"

Murdock, Gordon R. (B.A., Reed College). *Zoology.* Dissertation: "Field and Laboratory Studies in the Functioning of the Complex Enteron of Gorgonian Octocorals"

Neelon, Virginia Johnston (B.S.N., Duke University; M.S.N., University of California at San Francisco). *Physiology.* Dissertation: Potassium Uptake in a Strain of *Enterobacter (Aerobacter):* The Effect of Cell Size and Sugars"

Olsen, Kenneth Wayne (B.S., Iowa State University). *Biochemistry.* Dissertation: "The Purification and Mechanism of Lactose Synthetase"

Owens, Rufus Dalton (A.B., East Carolina University). *Chemistry.* Dissertation: "A Nuclear Magnetic Relaxation Study of Ligand Exchange of Some Diamines in Copper (II)-Water Systems at Several Temperatures"

Ozment, Nancy Elaine (A.B., Berry College). *Zoology.* Dissertation: "Fine Structure of Meiosis and Mitosis in Steatococcus Tuberculatus Morrison: The Structure and Cytochemistry of the Diffuse Kinetochore"

Parsons, Lawrence Reed (A.B., M.S., University of California-Davis). *Botany.* Dissertation: "Resistances to Water Flow in Plants"

Peery, William Powlas (A.B., Newberry College; B.S., Lutheran Theological Southern Seminary; M.A., Vanderbilt University). *Religion.* Dissertation: "A Christian Understanding of South Indian Vaisnavism"

Pizzo, Salvatore Vincent (B.S., St. Joseph's College). *Biochemistry.* Dissertation: "The Effect of Plasmin on the Subunit Structure of Human Fibrinogen and Fibrin"

Ridenhour, Thomas Eugene (A.B., Davidson College; B.D., Lutheran Theological Southern Seminary) *Religion.* Dissertation: "The Old Testament and the Patriarchal Traditions"

Romanas, Lampros Christos (B.S., M.S., University of Salonica). *Forestry.* Dissertation: "Environmental Control of Growth Patterns in Several Mediterranean Conifers"

Schueler, Robert Alan (B.A., University of Kansas; M.A., Duke University). *English.* Dissertation: "Functions and Purposes in the English Historical Novel of the Nineteenth Century"

Schwartz, Martin Lerner (A.B., University of Pennsylvania). *Biochemistry.* Dissertation: "I. Human Blood Clotting Factor XII (The Fibrin Stabilizing Factor) from Plasma and Platelets. II. The Crosslinking of Vertebrate Fibrin"

Scott, Graham Cecil (B.Com., M.Com., University of Canterbury). *Economics.* Dissertation: "Industrial Production and Investment in a Dynamic, Multiregional, Interindustry Model of the United States"

Seaks, Terry Gilpin (B.A., Washington and Lee University; M.A., Duke University). *Economics.* Dissertation: "An Econometric Model of Taiwan, 1952-1970"

Serow, William John (A.B., Boston College; M.A., Duke University). *Economics.* Dissertation: "Economic and Demographic Implications of a Stationary Population: A Case Study of the United States"

Sterner, Thomas E. (B.Sc. F., West Virginia University, M.Sc.F., Syracuse University). *Forestry.* Dissertation: "Decay Resistance in Roots of Balsam Fir"

Stevenson, Ruth MacDonald (A.B., Smith College; M.A., University of Richmond). *English.* Dissertation: "The Duality of Thomas Nashe"

Sussman, Robert Wald (B.A., University of California-Los Angeles). *Anthropology.* Dissertation: "An Ecological Study of Two Madagascan Primates: *Lemur Fulvus Rufus* (Audebert) and *Lemur Catta* (Linnaeus).

Teeri, James Arthur (B.S., M.S., University of New Hampshire). *Botany.* Dissertation: "Microenvironmental Adaptations of Local Populations of *Saxifraga Oppositifolia* in the High Arctic"

Thorne, Robert Earl (A.B., M.A.T., University of North Carolina). *Education.* Dissertation: "A Semanticist and Campus Unrest: A Study of Samuel Ichiye Hayakawa in Thought and Action"

Tyrere, Harry Wakely (B.E.E.E., University of Miami; M.S., Duke University). *Electrical Engineering.* Dissertation: "Dynamic Range of Presentation in Acoustic Imaging Systems"

Vaughan, Theresa Phillips (B.A., Antioch College; M.A., American University). *Mathematics.* Dissertation: "Linear Transformations and Polynomials over Finite Fields"

Weinhaus, Frederick Michael (B.S., Washington University). *Physics.* Dissertation: "Pulsed Nuclear Magnetic Resonance Studies in Solid HCP Deuterium and Hydrogen"

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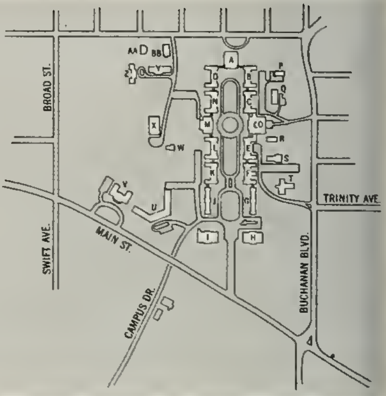
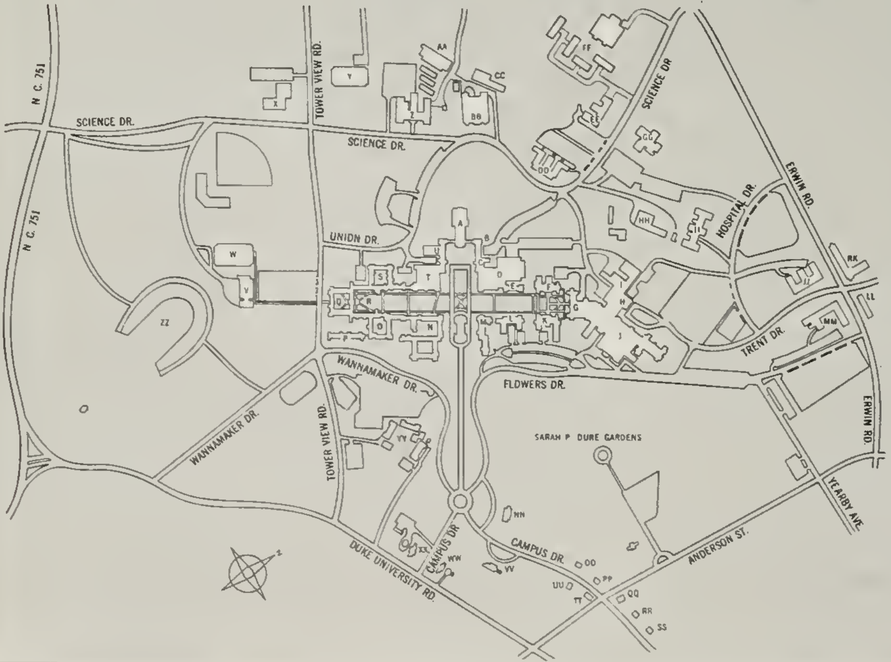
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laboratory
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanaline H. Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
DD	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Program
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



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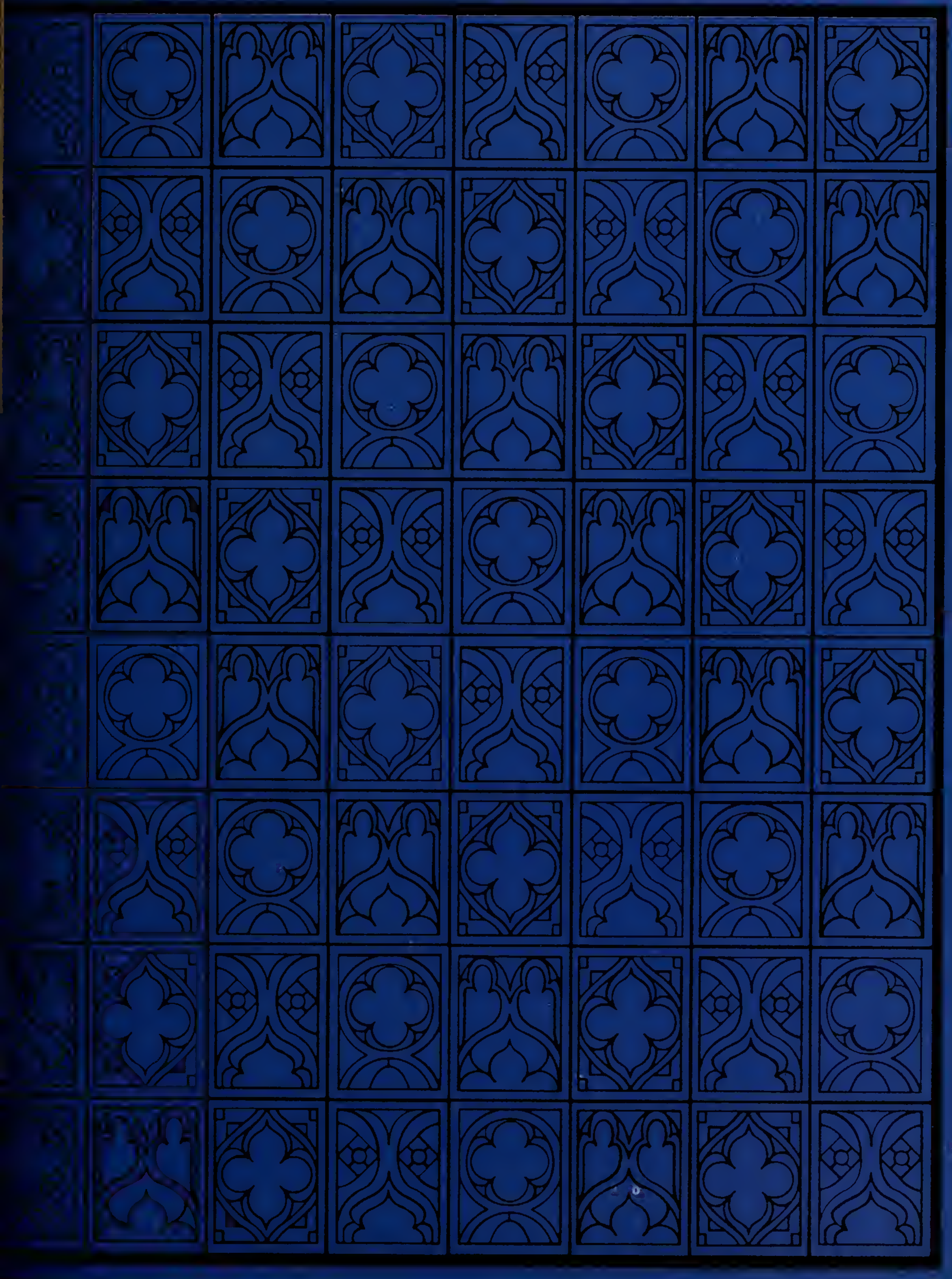
The Graduate School



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The Graduate School

1973-1974

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To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

> The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise in futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.
>
> Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education, Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.

John C. McKinney

John C. McKinney
Dean of the Graduate School

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*Term expires September, 1973.

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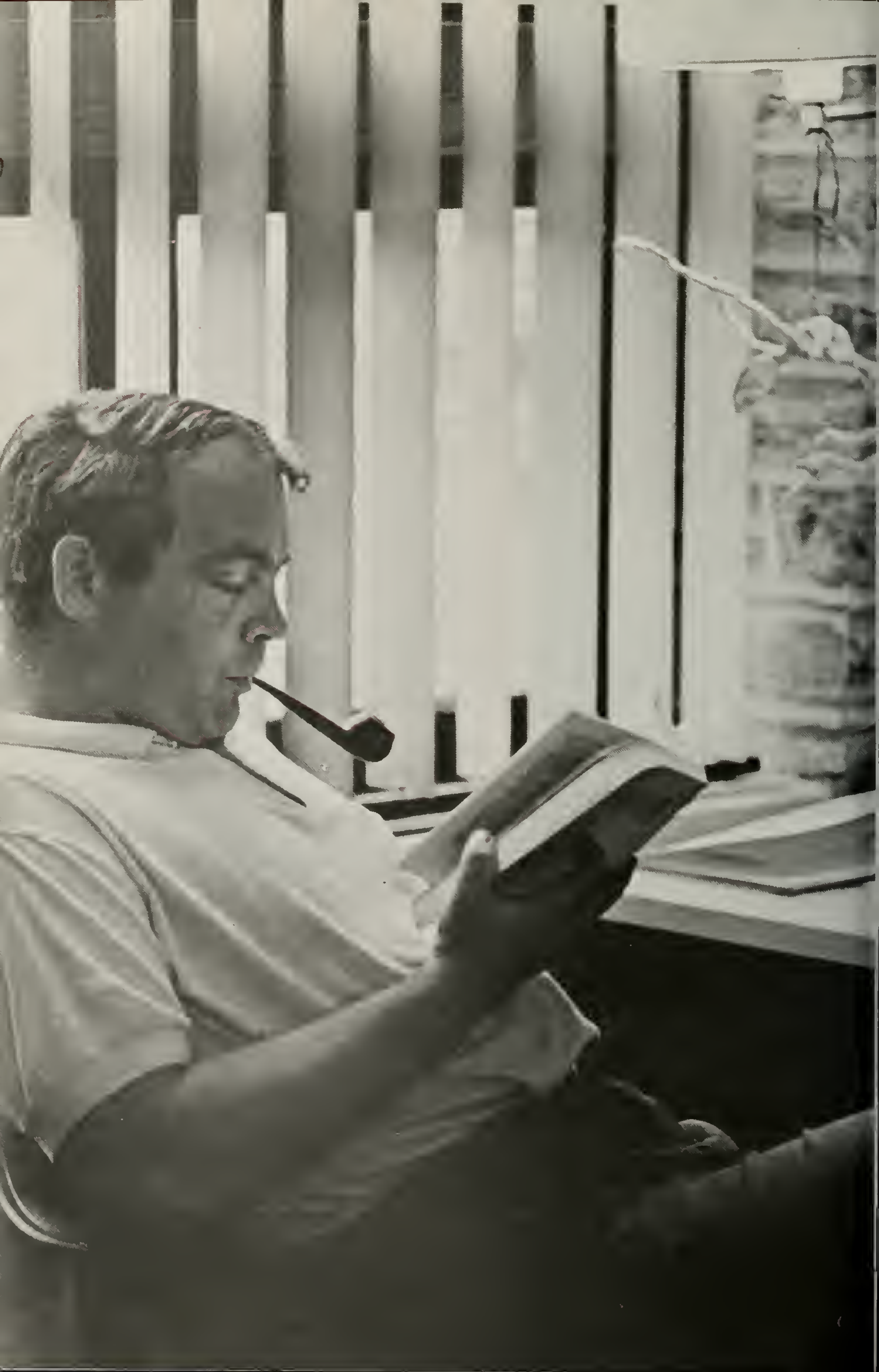


Introduction

Writing in the 1920's, the philosopher and man of science Alfred North Whitehead described the goal of higher education in these terms: "The task of a University is the creation of the future." It is only ninety years since the founding of the first formally organized graduate school in the United States, but it has become most evident that graduate schools, through their training of teachers, researchers, industrial specialists, scientists, and government advisers, play one of the most vital roles in "the creation of the future."

Ideally, a graduate school is a community of scholars—apprentice, initiate, and master—engaged in imparting and extending the realm of man's knowledge in the arts and sciences. A select group of students is admitted each year to undergo the rigorous discipline of an advanced degree program, the successful among them to emerge as scholars of promise. To enter upon graduate education today is to accept a real challenge, but the decision should not be made lightly or casually. The work toward a doctorate involves several years of tireless effort and possible sacrifice, and the material rewards may be less certain or less bountiful than in some alternative occupation. Pursued with determination, however, graduate education may be the doorway to a stimulating, creative, and meaningful life—a life which few persons who have chosen it would exchange if they had the opportunity of reliving their student years.

The student who is contemplating this challenge usually has many questions in mind; the following pages are an attempt to answer some of them. Many of the comments are applicable to programs at any university for a variety of degrees, although emphasis is placed here on the graduate programs at Duke University.

Should I Go to Graduate School?

This question can ultimately be answered only by the questioner himself. The decision to work toward an advanced degree must be a personal commitment born of a real willingness to devote oneself to many months or possibly years of hard intellectual work just at the age when one may be impatient for financial independence and freedom from academic discipline. Graduate education requires all the energy, enthusiasm, and self-discipline at one's disposal; to enter upon it half-heartedly is to invite discouragement or failure.

An equally important requisite for success in graduate study is the possession of a keen and disciplined intellect. Of this it can only be said that "the proof of the pudding is in the eating." A good undergraduate record may or may not be adequate evidence of ability. Many a student with an excellent undergraduate record has been unsuccessful in graduate study, because his undergraduate training stressed an ability to marshal facts and to articulate these facts rather than real understanding and analysis of material. On the other hand, many distinguished scholars had undistinguished undergraduate records. It may be of some comfort to remember that Einstein had difficulty in mastering simple mathematics (although one should be certain that he is another Einstein before using this fact as an easy excuse). In gaining admission to a graduate school, the undergraduate record is of course an important element, but usually some margin is left to allow for the student who develops a serious academic interest only at a late stage. The student himself is often better able to judge whether his grade record is a true gauge of his ability or represents an under-par performance.

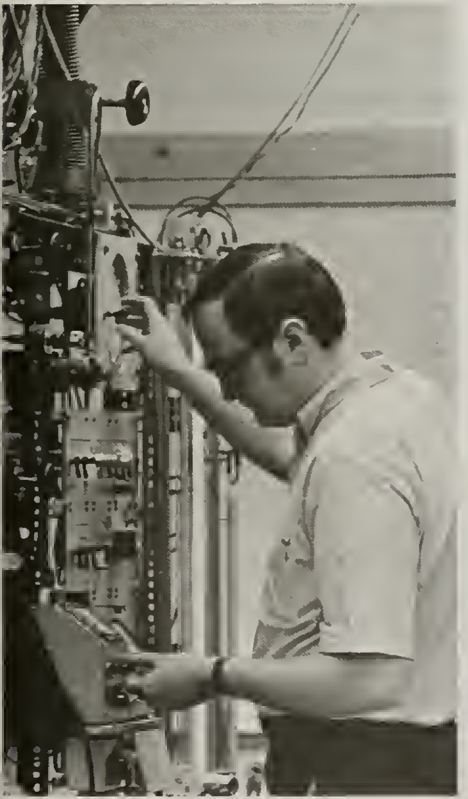
If a student feels he has both the ability and a strong desire to accept the challenge, he should not let other obstacles influence his decision unduly. About two-thirds of current students enrolled in Ph.D. programs in American universities have sufficient financial support from universities, industries, or foundations to meet the minimum cost, and most universities have loan provisions to help the student without adequate resources. Today about 60 percent of graduate students are married, and a majority of student's spouses work part or full time during the student's periods of residence. Indeed, many spouses pursue an advanced program concurrently.

There is no certain way of knowing in advance whether one will be successful or happy in graduate school; in this regard it differs little from any other career path one may choose to follow. It is quite likely, however, that if one has both the motivation and the ability and does not try it, there will be regrets in later years. Although this must be an individual choice, superior intellectual ability is a scarce human resource, and its encouragement and utilization are areas of national as well as personal concern.

How Should a Graduate School Be Chosen?

Over two hundred and fifty universities today offer work leading to the Ph.D. degree. Among these are about sixty institutions which grant only two or three such degrees a year in all fields combined. At the other end of the scale are about forty universities which account for nearly 70 percent of all doctorates granted in this country. Duke University is among these latter, as are most of the major institutions which offer work of quality ranging across a breadth of academic disciplines. But even if one can narrow the field to about forty major institutions, how does one select among these, and what factors should affect one's final choice? A few key factors are briefly discussed below.

Size. Size is not an infallible guide to the quality of a graduate school. There are a number of poor graduate schools of exceedingly large size, and a number of extremely good small ones. There are advantages, however, in attending a university which has attained a certain level of size, although it is difficult to provide a magic number to use as a yardstick. It is simpler to mention a few of the disadvantages of too many or too few students.



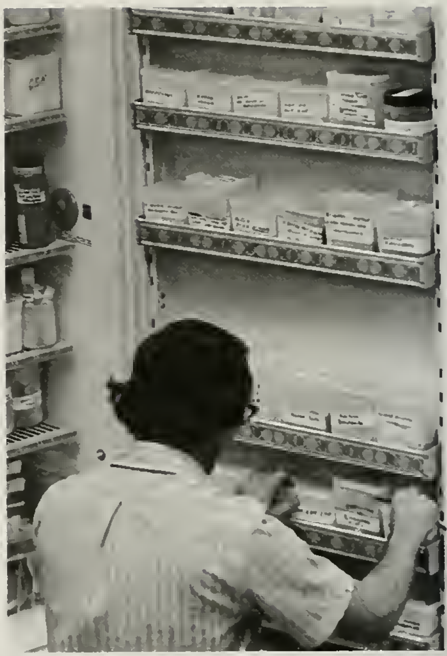
An extremely large graduate school —and there are a few today which have between six and twelve thousand enrolled—is a rather far cry from the ideal of a small number of superior students working closely in intellectual pursuits with a few esteemed scholars. Classes of fifty to a hundred students, inaccessibility of senior faculty, shortage of library materials and facilities, only a nodding acquaintance with fellow students—these are only a few of the possible drawbacks. A very able student may develop well even in such an atmosphere of mass production, but this situation is hardly the ideal.

An extremely small graduate school also has its disadvantages. Most of the classes are likely to be mixed undergraduate-graduate classes, where a student is not surrounded by many other good students who will help to sharpen his powers and create an atmosphere conducive to learning. Also, facilities are often very limited, and the faculty is likely to be primarily composed of undergraduate instructors. A university must be willing to commit a significant portion of its resources to develop a graduate program of high quality, and this is often not the case in an extremely small graduate school.

More important than the size of the entire graduate school is the size of the particular departmental program in which a student is interested. An optimum doctoral program will have an enrollment of perhaps thirty to one hundred students, admitting fifteen to forty new students each year, and turning out perhaps three to ten Ph.D.'s per year. Information on enrollment or degrees conferred is usually available in university catalogues or government publications on higher education, and a prospective student may find it useful to compare enrollments in various institutions before choosing a school.

Duke University is firmly committed to programs of moderate size where the interests of the student are paramount. Total enrollment in the Graduate School is about 1,800 students. Between four and five hundred new students are admitted each year from approximately four thousand applications. Only four departments have more than eighty students; seventeen departments have enrollments that fall within the optimum range suggested in the preceding paragraph.

Quality. Not only do universities differ considerably in their reputation for quality, but there are marked differences among departments within any university. Harvard, for example, is a great university because it has many reputable departments, not because it is best in every category. On the contrary, many excellent universities have a few weak departments in which a student would fare less well than he might in an excellent department in a less esteemed institution. Therefore, the student should not be guided solely by the reputation of a university as a whole, but should inquire more specifically about the area in which he wishes to specialize.



Since judging the quality of a graduate program is necessarily subjective, no two people are likely to be in complete agreement. The prospective student would do well to talk with his professors in his undergraduate college, particularly those who have themselves achieved some reputation in the world of scholarship. As witnessed by their own continuing writing and research, they are more likely to have reliable information on the merits of various graduate programs. Similarly, the younger faculty member who is only four or five years out of graduate school may have more recent acquaintance with his and other schools.

Another yardstick to quality, albeit an imperfect one, may be the occasional questionnaires asking other educators to rank various graduate departments. In the most recent American Council on Education report, of the 23 Duke graduate programs evaluated, 13 were rated as "distinguished" or "strong," eight were rated as "good," and two were rated as "adequate plus."

None of these guides is adequate in itself, but taken in conjunction with individual advice and recommendations they may help the student in his selection. An extremely good student can obtain a good graduate education in a number of universities, but in such an important choice it pays to be as well informed as possible.

The best procedure is to take many factors into account in choosing where to apply for admission, and then make application at the three or four schools one would most like to attend. (Applying at fifteen universities is merely a waste of an applicant's and the universities' time.) It is wisest not to make a final selection solely on the basis of financial aid available, on the advice of a single friend or adviser, or on a university's past prestige. One should get as much current information as one can. Write to the graduate school or the departmental director of graduate studies if further information is desired; visit the university in person, if possible; and carefully weigh the advice of the more distinguished faculty members of one's undergraduate college.

How Long Will It Take?

One of the primary questions in the mind of every student considering graduate study is "how long will it take?" This is not an easy question, however, for the answer depends partly on the requirements of the student's program, partly on the student himself, and partly on the attitude in the graduate school and the department in which he is studying.

The student's level of preparation before entering graduate school has a direct bearing on the speed with which he can progress toward a degree. One who enters with proficiency in one or more foreign languages and a good foundation in his chosen subject area may well be able to finish within the minimum time limits. On the other hand, the less well prepared student may find that one and a half to two years are the minimum for the A.M., and four to five years for the Ph.D. (although wise use of the summers may reduce this time somewhat). The total time may also be lengthened if

the student must work during part of his period of residence. (More on this subject will be found below, under "How Can I Pay for It?")

The attitude of the graduate school and its various departments will also affect the time needed to complete the degree. During the last decade the average time elapsing between entering graduate school and receiving the doctorate in American universities has been about ten years. A study of experience at Duke during the early 1950's indicated that the average doctorate in the humanities required a little over seven years, nearly six years in the social sciences, and slightly over four years in the sciences. Over the last few years, however, Duke University has been among the forerunners in reducing the time needed to obtain the Ph.D. without any sacrifice in quality. This effort has taken the form of trying to eliminate the unnecessary delays, particularly those due to financial burdens on the student. Duke ranks among the leading institutions in the country today in terms of financial aid per student from university sources. Moreover, much of this aid is in the form of fellowships and scholarships which do not require burdensome services in return. The large public institutions are often more restricted to awards which require substantial teaching, research, or other duties, thus reducing the speed with which a student can complete his resident course work. A student will be wise to inquire to what extent his progress toward a degree may be delayed by the work entailed in certain awards. If, for example, an assistantship lengthens unduly the time necessary to obtain a degree, even a smaller fellowship may be preferable.

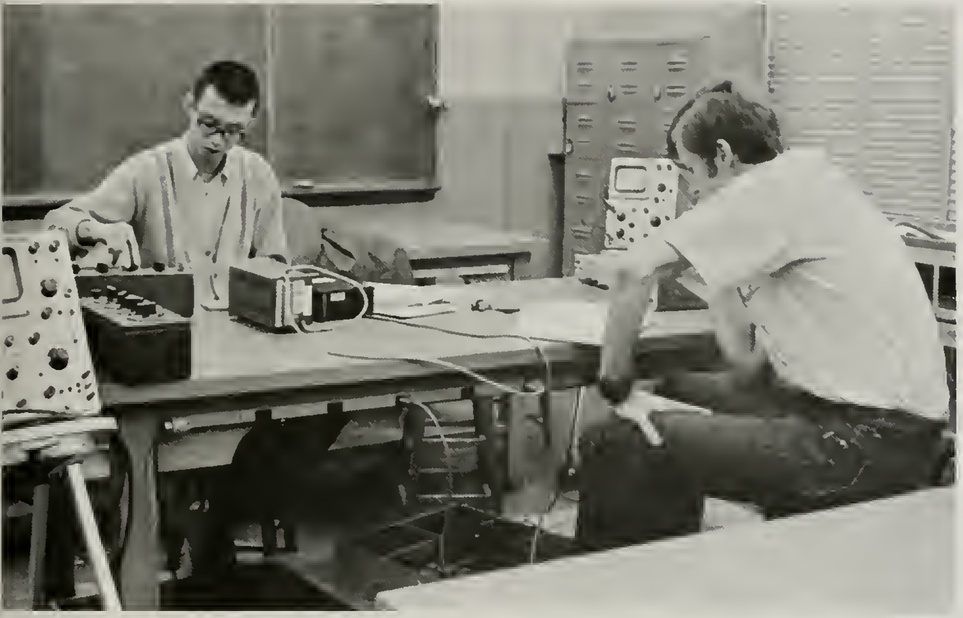
Another way in which Duke encourages deliberate speed toward fulfilling degree requirements is through its tuition charges. Many graduate schools charge tuition for three full years in a doctoral program. In 1958 Duke adopted the policy of charging full tuition and fees only up to the time the doctoral student passes his preliminary examination. (This examination is taken upon completion of all course and language requirements, normally at the end of the second year, before the student is formally admitted to candidacy for the Ph.D.) After "prelims," tuition charges are substantially reduced. In making his choice of a graduate school, a prospective student should inquire about the fees for a full doctoral program, not merely the charges for the first year. The tuition and fee system at Duke has worked to encourage both the student and his department to arrange for preliminary examinations to be taken before the beginning of the third year. Some years ago fewer than half of the doctoral students at Duke took this examination before the beginning of the third year; today over 90 percent are doing so. This plan, aided by liberal scholarship and fellowship aid, gives the graduate student at Duke a marked advantage over his counterparts in many other graduate schools in acquiring his degree in the minimum amount of time.

How long it will take to obtain an advanced degree, therefore, depends on many factors, but the policy of the Duke Graduate School is to keep time at a minimum and consistent with continuing quality in its graduate program.

How Can I Pay For It?

The typical entering graduate student, after completing his four-year undergraduate program, may not be able to continue with support from his family or from part-time earnings. All graduate schools, in order to minimize financial barriers for superior students, have at least modest funds at their disposal in the form of scholarships, fellowships, or assistantships. Few private universities have sufficient funds to aid more than half of their graduate students and often make total awards which are considerably greater than their entire tuition income from such students.

In recent years at Duke about 80 percent of all full-time students have held an award of some type; about one third of these were aided by Duke



funds and the other two-thirds by funds from other sources.

The student who seeks financial aid from the graduate school of his choice should be certain that he files his request for admission and award at a sufficiently early date. An application should be completed not later than February 1 of the year in which September admission is sought. At Duke, the student's application, including transcripts of his previous college work and letters of recommendation, is processed by the Graduate School and forwarded to the department in which he wishes to pursue advanced work. The graduate faculty—or admissions committee—in the department reviews all applications and then makes its recommendation to the Dean for announcement in late March. The most outstanding applicants are then offered awards; the next in order of rank are placed on an alternate list for awards. Other students whom we want to attend are offered only admission to the Graduate School. Because of multiple applications by students, a fraction of the awards offered by any graduate school are turned down by students who finally decide to go elsewhere. Alternates on the award list are immediately notified, and the process continues until the desired number of awards has been made.

The determining factors in the student's position in these rankings are the letters of recommendation, the undergraduate record, and (if required) pre-entrance test scores on the Graduate Record Examination. The quality of some capable applicants is not always evident according to these criteria, although they may turn out to be excellent students after admission. Often part-time jobs, extracurricular activities, lack of seriousness of purpose at an early age, or similar factors make a student's undergraduate record a poor gauge of his capabilities. The Graduate School, however, must judge as best it can from limited information, admittedly making occasional errors in judgment. Letters of recommendation usually weigh heavily when the writer is a scholar held in high esteem by the faculty of the school to which application is made.

Entering graduate school for the first year without an award will not prejudice one's chances for a later award. In the spring of the first year, the graduate faculty reviews the progress of all current award holders and weighs the applications of others.

Awards for the second and third years are made almost entirely as a result of the student's record in the graduate program. Thus, it is often a wiser course in the long run to enter a good graduate school without an initial award than to go to a less attractive school with modest financial aid.

Awards to entering students at Duke are in the form of fellowships, scholarships, and assistantships.

James B. Duke Graduate Fellowships are provided through a special endowment of the Duke Endowment. Fellows are chosen from nominations made by the departments. Only outstanding applicants who are beginning graduate study and seeking the Ph.D. degree are considered. These nominations are made in late February and are judged in a competition which includes all departments granting the Ph.D. degree. These fellowships provide for payment of tuition for full registration and stipend of $290 per month for the full calendar year during the first two years and for the academic year during the third (final) year. The award requires no service beyond that which is required of all students in a given department as a part of their training and is renewable each year upon satisfactory progress. The total value of the award is $5,885 for each of the first two years. The total value of a James B. Duke Fellowship over the full three years of tenure is $14,938.

Graduate Fellowships range in value from about $2,400 for the academic year to $5,150 for the calendar year and are made on a year-to-year basis. They are awarded upon recommendation by each department. No service is required as a prerequisite for accepting a fellowship, but all fellowship holders are expected to maintain full-time registration.

University funds have been made available to stimulate the admission and matriculation of well-qualified black students in the Graduate School. These funds are to supply fellowship support to six students during the next academic year.

Graduate Scholarships provide for payment of tuition or partial tuition. Full tuition scholarships are valued at $2,340 for the academic year. Scholarships are awarded upon recommendation of each department.

Graduate Assistantships range in value to $4,530 for the academic year.

Assistantships normally require services of the student up to twelve hours a week and permit the student to register for a four-fifths course load. Assistantships are most common in the science departments, where the student often provides laboratory assistance to various members of the faculty. Most graduate assistants remain in residence for at least one of the summer sessions during their first two years, carrying sufficient research or course credit so that they can complete their residence requirement of 60 units within two years. In this way, the normal progress toward a degree is not impeded by the reduced load during the fall and spring semesters. Departmental research funds are often available to provide financial assistance during the summer.

Other Graduate Fellowships are available from foundations, industry, or the government. Among those at the University's disposal are James B. Duke Commonwealth fellowships for students in political science, economics, and history, concentrating their studies on the British Commonwealth; Kearns fellowships in religion; Lilly Foundation fellowships in political science, C. W. Hargitt research fellowships in zoology; and Cokesbury awards for the preparation for college teaching. In 1972-73 there were 50 students holding three-year fellowships awarded by Duke under Title IV of the National Defense Education Act. Another six students held Foreign Language Fellowships awarded by Duke University under Title VI of the National Defense Education Act in Southeast Asia Area Studies. A number of other traineeships and assistantships are available in the biological, physical, and social sciences under grants from National Institutes of Health, National Institutes of Mental Health, National Science Foundation, National Aeronautics and Space Administration, Atomic Energy Commission, research agencies in the Department of Defense, and other governmental agencies.

Loan funds are also available for students who do not have sufficient resources at their disposal. Loans may be obtained either from the National Defense Act Loan fund or from University funds. These provide favorable interest charges and repayment terms. Further information may be obtained from the Financial Aid Office of the University.

It is difficult to estimate a student's financial needs during the years of graduate study because of individual tastes and habits. One can predict with some accuracy, however, the three major items of expense at Duke: tuition, $2,340 for a full program for each of the first two years, normally $468 for the Ph.D. dissertation year; room rent, $371-$497 each year in graduate dormitories; and board, approximately $700-$750 in graduate dining halls. Students holding awards are normally paid in nine equal installments beginning in late September, and tuition and room fees may be deducted monthly on a pro rata basis.

The costs of graduate education are high, but Duke University attempts to allocate its funds so that the superior student is able to finish his work for a degree in the normal length of time regardless of his personal financial resources. This is a contribution to the community of scholarship which the University is glad to bear.

Duke University Graduate School

In surveying the progress made in the first seven years after the founding of Duke University, its first President, William Preston Few, wrote that he wanted "to see the Graduate School made strong because it will best and most quickly insure our attaining and maintaining a place of real leadership in the educational world." President Few believed that "more than anything else here our Graduate School will determine the sort of University we are to build and its standing in the educational world." These opinions have continued to prevail to the present day, with emphasis upon the interdependence of teaching and research as the necessary components of scholarship.

Over five hundred members of the graduate faculty teach the approximately six hundred courses and seminars offered in the Graduate School, and supervise thesis and dissertation research. Many of the major universities of the world have helped to train this faculty; approximately 90 percent of the graduate staff hold degrees from the forty-six institutions which make up the Association of Graduate Schools within the Association of American Universities. By place of birth they represent almost every state in the Union and almost two dozen foreign countries.

The eighteen hundred graduate students currently enrolled represent a similar diversity in background. Approximately 41 percent of the students recently completing doctoral degrees are from undergraduate colleges in the Southeast, 16 percent from the Middle Atlantic states, 12 percent from New England, 11 percent from the Central states, 7 percent from the Southwest, 2 percent from the Northwest, 1 percent from the Far West, and 10 percent from foreign countries. The old maxim that a university is only as good as its faculty might be amended by adding "and no better than its student body." No professor can give his wisdom to a student, and no student can take his understanding to another. This must be a reciprocal process between professor and student, and between student and student. The groundwork for learning may be laid in privacy—indeed a certain amount of private study and research is absolutely essential—but the vital stimulus to the learning process comes from one's contact with the minds of other men with similar or related interests. This is precisely why graduate schools are highly selective in their admissions policy, and it is one of the important reasons for their willingness to offer attractive fellowship awards to outstanding students. The superior student is a valuable catalyst both for his fellow students and for his faculty, and is prized as such.

Faculty and students comprise the essential human factors in education, but their joint endeavor cannot prosper without adequate research and library facilities. Duke University is particularly fortunate in regard to research facilities, for the physics, botany, zoology, chemistry, psychology, sociology, engineering, and biochemistry laboratories have been built entirely within recent years, and modernization and expansion have occurred in other scientific areas. The University shares a magnificent computing facility with the University of North Carolina and North Carolina State University. The Triangle Universities Computation Center is among the largest research-oriented computer facilities in the world. It is also the University's pride that it has one of the finest research libraries, the twentieth largest university library in the nation today, second in the South, and first in the Southeast. In number of volumes, breadth of coverage, serials, and documents, it is a much more adequate library than that available in many graduate schools with enrollment two or three times as large. To the student in the arts, humanities, and social sciences, for whom the library is the bloodstream of scholarship, this is an immeasurable asset.

Among the many special features of the Graduate School a few important examples may be mentioned. For students in the biological sciences, the facilities of the Duke Marine Laboratory at Beaufort, North Carolina, are available for course work and research. The Laboratory has research buildings, classrooms, motor vessels (including the 118-foot oceanographic ship, the *R/V Eastward*), and living quarters, which make it one of the best research centers in marine biology in the country. Closer to home are the 8,000 acres of the Duke Forest, managed by the School of Forestry, ideal for research on timber growth, soils, and related topics. A large phytotron has recently been completed. Students in both the physical and the life sciences frequently avail themselves of the facilities of the Oak Ridge Institute of Nuclear Studies, of which Duke is one of the sponsoring Universities.

In the social sciences the Center for Commonwealth Studies is internationally recognized for its graduate training and research program. The center is a cooperative enterprise of the Political Science, Economics, and History Departments. Other important graduate programs with an international orientation focus on Europe South Asia, Sub-Saharan Africa, and South America. These involve sociology and anthropology in addition to the other social sciences.

Other special teaching or research programs include the Program in Christianity and the Social Order, jointly conducted by the Departments of

Political Science and Religion; the Center for Demographic Studies; conducted by the Departments of Sociology and Economics; the Social Systems Simulation Program, jointly sponsored by all the social sciences; the Program in Aging and Human Development, primarily based in Sociology, Psychology, and Psychiatry; The General Motors Institute Bachelor-Masters Plan; and numerous others such as the cooperative programs with the University of North Carolina in the humanities. Duke is also fortunate in having excellent Medical, Law, Engineering, Forestry, and Divinity Schools on its main campus, thus making additional facilities available for course or research work related to the graduate curricula in the arts and sciences. A three-term summer session and the availability of courses in the nearby University of North Carolina and North Carolina State University under a cooperative arrangement offer other opportunities to the graduate student.

No description of programs can begin to give the prospective student the full flavor of graduate study in a particular institution. A visit to the universities in which one is particularly interested may be helpful in giving one a better picture. If this should be practical, the Duke Graduate School offers a warm invitation to prospective students to come to the campus during the year to discuss their possible application and admission. The visitor will find at Duke most of the facilities that one could hope for in the largest of institutions, and yet the University has been fortunate in avoiding many of the evils inevitable with mass education. Despite the total University enrollment of approximately 8,000, Duke has retained the sense of community that one usually associates with a smaller liberal arts college. And in an age when current architectural whim often adds yet one

more variant style to an already assorted array of buildings, Duke has built with foresight and design a campus of unusual beauty. This, too, is an important part of the fabric of education, creating an environment conducive to learning.

General Regulations Governing Graduate Studies

The official detailed *Bulletin of the Graduate School,* published in February of each year, gives a detailed account of regulations concerning graduate work at Duke University and a full description of course content. The following pages are a summary of these materials for 1973-74 and should provide sufficient information for the prospective student. The *Bulletin* is normally mailed to each student who is admitted to the Graduate School in the late spring of the year of matriculation so that he may plan his course program for the first year. Copies may be obtained in February, however, by writing to the Graduate School Office, Duke University, Durham, N.C. 27706.

Admission

All applicants will be considered without regard to race, color, religion, sex, or national origin.

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as Special Students in the Summer Session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Normally he should have majored in the area of his intended graduate study. Many departments (see the section on Advanced Degree Programs at Duke) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see the section on Language Requirement).

A student seeking admission to the Graduate School should request the Dean of the Graduate School to send an application blank. This should be filled out completely and returned promptly. In addition the student should provide the following supporting documents; (1) two copies of a transcript or transcripts of all his undergraduate and graduate work mailed directly by the registrar to the Dean; (2) as soon as possible, two supplementary transcripts showing completion of work in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge him as a prospective graduate student and mailed directly to the Dean; and (4) scores on the Graduate Record Examination as indicated in the table below.

All applicants except former students in the Graduate School must include the application fee of $15.00 in check or money order payable to Duke University. Applications will not be processed unless this fee has been received.

Scores on the Graduate Record Examination, particularly the Aptitude Test are strongly recommended in all departments and must be submitted if the test has been taken. Scores on the Graduate Record Examination may be requested of any applicant whose record is marginal and must be submitted by all applicants for a fellowship. Students applying for financial aid should take the Graduate Record Examination no later than December in order to meet the February 1 deadline. Information on times and places of Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704. Departments that require scores of all applicants are listed below.

Department	Aptitude	Advanced
Anatomy	x	
Anthropology	x	
Art History	x	
Biochemistry	x	x
Botany	x	x
Business Administration[1]		
Chemistry	x	x
Classics	x	
Computer Science	x	
Economics	x	
English	x	x
Forestry	x	
Geology	x	
German	x	
Health Administration[1]		
History	x	
Mathematics	x	x
Microbiology	x	x
Pathology[2]	x	x
Philosophy	x	
Physical Therapy	x	
Physics	x	x
Physiology	x	x
Political Science	x	
Psychology	x	x
Religion	x	
Romance Languages	x	x
Sociology	x	x
Zoology	x	x

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[1] Applicants to the Graduate School of Business Administration and the Department of Health Administration are required to take the Admission Test for Graduate Study in Business, administered by the Educational Testing Service.

[2] If the candidate does not already hold a doctoral degree, he will be required to take the GRE.

Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with his application (1) if his native language is not English, certification of his proficiency in English demonstrated by submitting scores from the Test of English as a Foreign Language (TOEFL), administered through The Educational Testing Service in Princeton, New Jersey, or, if he is in the United States, a statement of his English proficiency written by a professor of English at his university; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per academic year are $4,000); and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack the necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units.

A student who does not successfully complete this course during the first year of his residence will not be permitted to continue his program. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language.

When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the acceptance form has been returned.

Applicants who are admitted will be offered full admission, provisional admission, or non-degree admission. *Provisional admission* is offered to students who appear to warrant admission but do not fully comply with admission requirements. It is offered for a trial period of one semester or 12 units of course work. *Non-degree* admission is offered to students who (1) have no intention of taking an advanced degree at Duke University but wish to take courses for accreditation for transfer to other institutions, or for other purposes, or (2) do not fully meet admission requirements but wish to further their academic interests. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission; graduate credit earned under non-degree status may not be applied toward an advanced degree at Duke University. (See ruling on page 20.)

It is the applicant's responsibility to make certain that his application is completed and in order before the dates specified. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted two weeks before the closing dates listed below.

We encourage all candidates to apply by February 1. Anyone whose folder is not complete before that date will face the possibility that the enrollment in his department will have been filled. While the Graduate School Office will process later applications, it will not guarantee full consideration of a folder for any department after April 15.

Fall semester, admission and award	February 1
Fall semester, admission only	July 15
Spring semester, admission only	December 1
Summer session, 1974[*] first term	April 15
Summer session, 1974[*] second term	May 15
Summer session, 1974[*] third term	June 15

[*] Students seeking admission to the Graduate School for study in the summer session should apply to the Dean of the Graduate School and to the Director of the Summer Session.

Earning the Degrees

Duke University offers graduate programs leading to the specified advanced degrees in the following fields:

Anatomy, A.M., Ph.D.
Anthropology, A.M., Ph.D.
Art History, A.M.
Biochemistry, A.M., Ph.D.
Biomedical Engineering, M.S., Ph.D.
Botany, A.M., Ph.D.
Business Administration, M.S.,[*] M.B.A., Ph.D.
Chemistry, A.M., Ph.D.
Civil Engineering, M.S., Ph.D.
Classical Studies, A.M., Ph.D.
Computer Science, A.M., Ph.D.
Economics, A.M., Ph.D.
Education, M.Ed., M.A.T., A.M., Ed.D., Ph.D.
Electrical Engineering, M.S., Ph.D.
English, A.M., Ph.D.
Forestry, A.M.[†] M.S., Ph.D.
Geology, A.M.
Germanic Languages and Literature, A.M.
Health Administration, M.H.A.
History, A.M., Ph.D.
Mathematics, A.M., M.S.[‖] Ph.D.
Mechanical Engineering, M.S., Ph.D.
Microbiology and Immunology, A.M., Ph.D.
Pathology, A.M., Ph.D.
Philosophy, A.M., Ph.D.
Physical Therapy, M.S.[‡]
Physics, A.M., Ph.D.
Physiology, A.M., Ph.D.
Political Science, A.M., Ph.D.
Psychology, A.M., Ph.D.
Religion, A.M.,[§] Ph.D.
Romance Languages, A.M., Ph.D.
Sociology, A.M., Ph.D.
Zoology, A.M., Ph.D.

[*] Applicants should write directly to the Graduate School of Business Administration for further information.

[†] In addition to the regular advanced degrees in the Graduate School, the School of Forestry offers the professional degrees of Master of Forestry and Doctor of Forestry.

[‡] Prospective applicants should write directly to the Department of Physical Therapy, Box 3247, Duke University Medical Center, Durham, N.C. 27710, for further information.

[§] In addition to the regular advanced degrees in the Graduate School, the Divinity School offers the professional degrees of Master of Divinity, Master of Religious Education, and Master of Theology.

[‖] In addition to the regular advanced degrees in the Graduate School, the Department of Mathematics offers the Master of Science in Statistics and Computing.

Programs leading to graduate degrees include course and seminar study prescribed by the individual departments. Evidence of command of and training in the tools of research (for example, foreign languages); guided and independent reading and laboratory and field experience; a period of residence with constant easy access to the library, laboratory, senior professors, and other graduate students; certain oral and written examinations to exhibit command of the declared field of study; and a master's thesis or doctoral dissertation as a public account of a body of knowledge the student has mastered. (In some departments it is possible to earn an A.M. degree without presentation of a thesis by completing additional course work or other equivalent academic exercises.) A final examination, generally focused upon the thesis or dissertation, enables the student to convince the graduate staff that he has fulfilled all the requirements of his program. Time limitations are set for completion of the program so that the initial ambition in undertaking graduate study and the momentum of accomplishment are not lost.

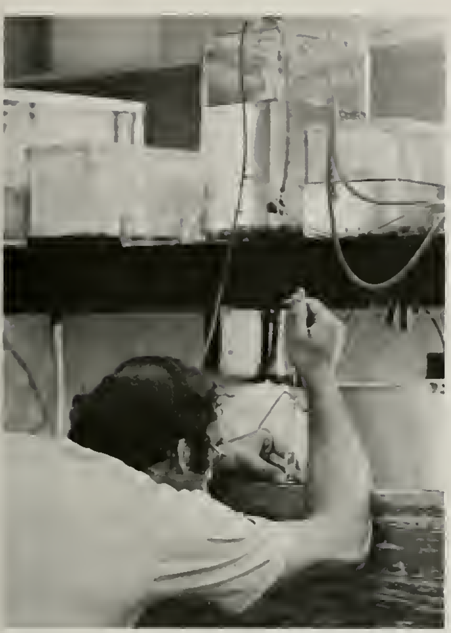
The Language Requirement

Although individual departments establish their own minimal requirements (see individual departmental headnotes in this *Bulletin*), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. The languages normally required are French, German, and Russian, but others may be offered if appropriate and approved. The foreign language requirement may be satisfied in the following ways: (1) by a passing score on one of the ETS examinations administered at any national center (including Duke) and taken no longer than six years before the preliminary examination, (2) by transfer from another institution, with the limitations set forth in the *Bulletin of the Graduate School*, (3) in any language for which ETS tests are not available, by a reading examination administered by a qualified examiner and arranged by the Graduate School Office, or (4) by a reading examination in any foreign language, administered by a qualified member of the faculty under a procedure specified by the department and approved by the Dean and the Executive Committee of the Graduate Faculty. In special circumstances a department that wishes to do so may ask the Dean and the Executive Committee of the Graduate Faculty to waive the language requirement.

Foreign students whose native language is not English will be examined during their first registration period in their use of English, and those found deficient will be required to enroll in the course entitled English for Foreign Students. Advanced level, non-credit reading courses in French and German are provided for students who need them.

Other Requirements

The general requirement for a master's degree is a *minimum* of 30 units (semester hours) of course-seminar-research credit. The student must present acceptable grades for a minimum of 24 units of graduate courses. The nature of the additional 6 units for which he must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the student's department. In the M.A.T. program, practice teaching is included for students who lack it, and for them the total units required is a minimum of 36. A pattern of major and related work is prescribed for the course-seminar work, allotting half or more of the units to the major. For example, the M.Ed. allows at least half the units to fall within the student's teaching field, and the M.A.T. allows a major in either education or teaching fields, according to the student's previous training.



A master's program can be completed in one academic year, but the student who presents a thesis normally needs at least a calendar year, and foreign students should be prepared to study for two years. The maximum span of time permitted from first registration to completion of all requirements is six years. Under certain circumstances a maximum credit of 6 units may be transferred toward the master's degree for graduate courses completed elsewhere, provided the grades earned in the particular courses were not less than *B* or equivalent. In such a case, however, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.

The course-seminar-research requirement in the doctoral program is a minimum of 60 units, but the proportions of course-seminar work and research are generally flexible according to the student's needs. The applicant who has already earned the A.M. or M.S. (or for a degree in religion, the B.D. or M.Div.), after establishing the quality of his work here, may be granted transfer credit to a maximum of 30 units, i.e., the equivalent of one year of residence. The dissertation is expected to be a mature and competent piece of writing, embodying the results of original and significant research. All dissertations will be published on microfilm, and the author may retain copyright privileges.

Fairly strict time limitations are set for completion of the doctoral program. The preliminary examination, which may be taken only after language and course-seminar requirements have been met, and which formally admits a student to candidacy for the degree, should be passed by the end of the third year of doctoral study. The interval between preliminary examination and presentation of an acceptable dissertation should normally be one to two years and may not be more than four years without special approval by the Dean. Should this interval extend beyond five years, a second preliminary examination normally becomes necessary.

Financial Regulations

Tuition and fees are charged at the rate of $78.00 per unit (a unit is equivalent to a semester hour), with the normal full program of study being 30 units for an academic year. Upon successful completion of the preliminary examination and at least 60 units of course-seminar-research credits, the normal full program during the dissertation period is 3 units per semester while in residence, or 1 unit per semester while not in residence. The basic necessary expenses for a year of graduate study, assuming one lives in University graduate dormitories, are therefore approximately as follows:

	First and Second Year	*Dissertation Year*
Tuition	$2,340	$468
Room Rent*	371	371
Board†	700	700

*Depending upon accommodations chosen.
†Cafeteria estimate.

Additional allowances should be made for books, laundry, and other personal expenditures.

Housing is provided for approximately 189 single men and 56 single women in the Graduate Center. The Town House Apartments, located between East and West Campuses, will accommodate three women in each of 30 air-conditioned apartments.

Since no married student housing facilities are available, the University provides assistance to married graduate and professional school students in locating suitable housing in Durham.

Information on fellowships, scholarships, assistantships, and loan provisions is summarized in the section, "How Can I Pay for It?

The applicant who wishes further information on facilities and regulations on course programs not covered in this *Bulletin* is invited to write to the Director of Admissions of the Graduate School, or the director of graduate studies in the department of intended study.

Calendar of the Graduate School

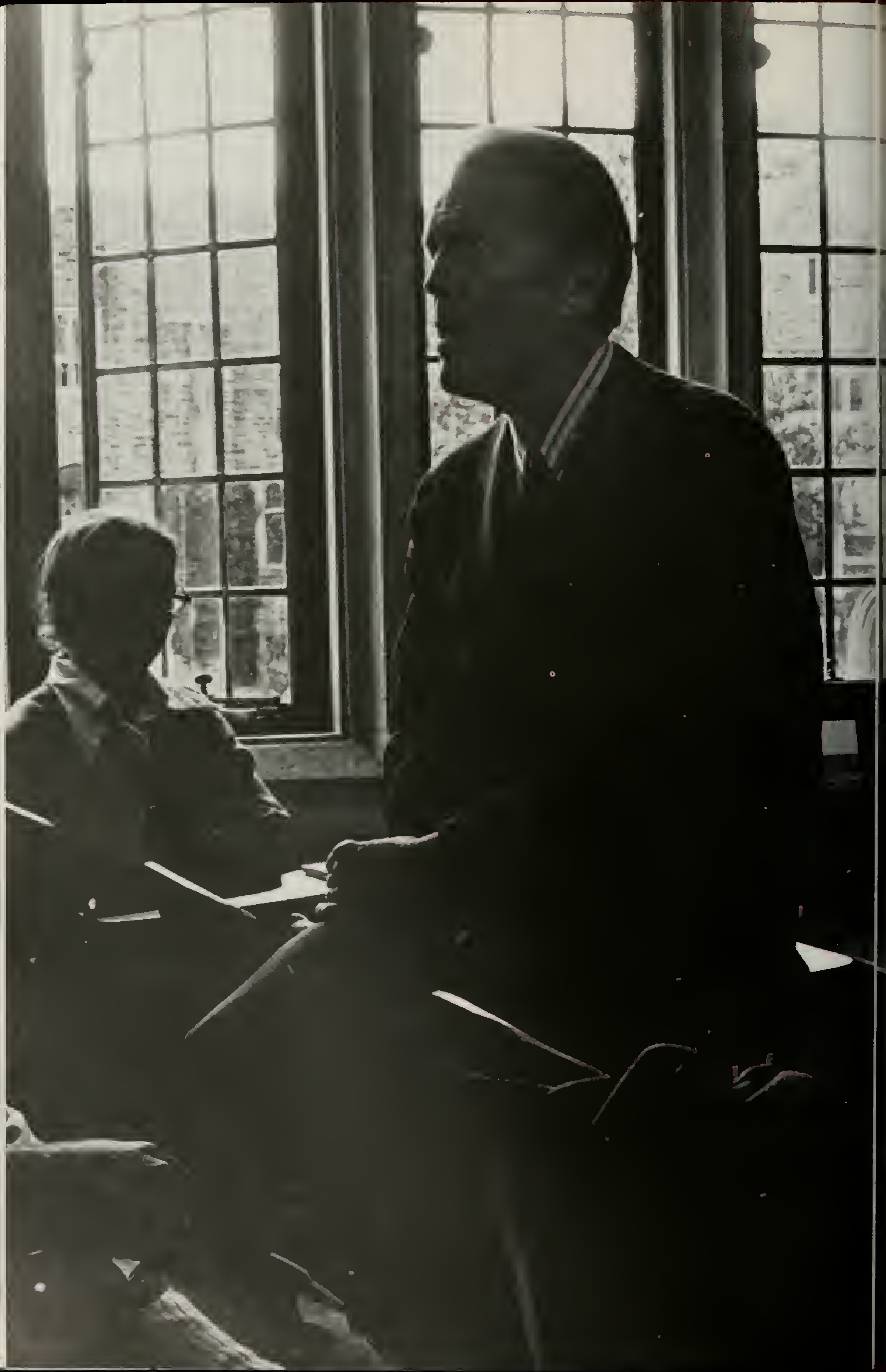
Summer Session 1973

First Term: May 14-June 15
Second Term: June 18-July 20
Third Term: July 23-August 24

Academic Year 1973-74

First Semester: September 4-December 21
Second Semester: January 14-May 7

August 31	Registration for First Semester
September 4	Classes Begin
November 21-25	Thanksgiving Recess
December 7-13	Reading Period
December 21	End of First Semester
January 11	Registration for Second Semester
January 14	Classes Begin
March 16-24	Spring Recess
April 23-29	Reading Period
May 7	End of Second Semester
May 12	Commencement



Advanced Degree Programs*

Anatomy

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; both A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core anatomical sciences course (Anatomy 301) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas, including biochemical and biophysical cytology, biological motility, cell biology, developmental biology, endocrinology, neurobiology, physical anthropology, membrane structure and function, and primate biology. Further information may be obtained from the Director of Graduate Studies of the department.

Professors

John Buettner-Janusch, Ph.D. (Michigan); John Wendell Everett, Ph.D. (Yale); J. Moses, Ph.D. (Columbia); Talmadge Lee Peele, M.D. (Duke); J. David Robertson, M.D. (Harvard), Ph.D. (MIT), *Chairman.*

Associate Professors

Sheila J. Counce, Ph.D. (Edinburgh); Kenneth Lindsay Duke, Ph.D. (Duke); William Longley, Ph.D. (London); Michael K. Reedy, M.D. (Washington).

Assistant Professors

Mark Adelman, Ph.D. (Chicago), *Director of Graduate Studies;* Jan Bergeron, V.M.D. (Pennsylvania); Charles Blake, Ph.D. (California at Los Angeles); Matthew Cartmill, Ph.D. (Chicago); Harold Erickson, Ph.D. (Johns Hopkins); William C. Hall, Ph.D. (Duke); William Hylander, Ph.D. (Chicago); Kurt E. Johnson, Ph.D. (Yale); Moses S. Mahaley, M.D., Ph.D. (Duke); James Shafland, Ph.D. (Chicago); Jacqueline A. Reynolds, Ph.D. (Washington).

*(For full course descriptions including credit and name of instructor see the official detailed *Bulletin of the Graduate School.)*

Courses of Instruction

207. Human Anatomy
208. Anatomy of the Trunk
210. Introduction to Human Structure
216. Anatomy of the Head and Neck
219. Molecular and Cellular Basis of Development
219S. Seminar
231. Human Evolution I
232. Human Evolution II
236. Human Genetics
238. Function and Evolutionary Morphology of Primates
246. The Primate Fossil Record
261. History of Generation and Mammalian Reproduction
263. History of Anatomy
264. Mammalian Embryology and Developmental Anatomy
266. Topics in Cell Structure and Function
271. Comparative Neurology and Psychology
280. Molecular Basis of Anatomy
*284. Tutorial in Developmental Biology
286. Optical Methods in Biophysical Cytology
*288. The Cell in Development and Heredity
290. Membrane Structure
291. Special Topics in Nerve Ultrastructure
300. Gross Anatomy
301. Gross Human Anatomy, Microscopic Anatomy, and Neuroanatomy
303. Neuroanatomical Basis of Behavior
312. Research
313, 314. Anatomy Seminar
331, 332. Primate Seminar
333. Primate Evolution
334. Topics in Physical Anthropology
340. Tutorial in Advanced Anatomy
344. Advanced Neuroanatomy of Sensory and Motor Mechanisms
354. Research Techniques in Anatomy
403. Endocrinology and Reproduction

*Not offered spring, 1974.

Anthropology

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for a Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these subfields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies for Anthropology, Department of Anthropology.

Professor

Weston LaBarre, Ph.D. (Yale), *James B. Duke Professor of Anthropology.*

Associate Professors

Mahadeo L. Apte, Ph.D. (Wisconsin); Richard G. Fox, Ph.D. (Michigan), *Acting Chairman.*

Assistant Professors

Matthew Cartmill, Ph.D. (Chicago); Ronald W. Casson, Ph.D. (Stanford); William Hylander, Ph.D. (Chicago); William M. O'Barr, Ph.D. (Northwestern), *Director of Graduate Studies;* Naomi Quinn, Ph.D. (Stanford).

Instructor

Jonathan M. Kress, Ph.D. (Yale).

Courses of Instruction

220. Society and Culture in India
222. Topics in African Anthropology
231. Human Evolution I
232. Human Evolution II
236. Human Genetics
240. Indo-Aryan Linguistics
243. Seminar in Theory and Method in Archaeology

245. Functional and Evolutionary Morphology of Primates
246. The Primate Fossil Record
249. Economic Anthropology
250. The Anthropology of Cities
259. Linguistic Anthropology: Language Acquisition
260. Linguistic Anthropology: Phonemics
261. Linguistic Anthropology: Morphology and Syntax
262. Anthropology of Law
263. Primitive Art and Music
264. Primitive Religion
265. Personality and Society
266. Personality and Culture
270. Seminar in Ethnographic Field Methods
271. Seminar in Methods of Data Analysis
274. Statistics Methods in Anthropology
275. Rank. Power. and Authority in Pre-Industrial Societies
276. Analysis of Kinship Systems
278. Special Topics in Political Anthropology
280, 281. Seminar in Selected Topics
291, 292. Anthropological Theory
330, 331. Seminar in Anthropology
333. Primate Evolution
334. Topics in Physical Anthropology
335, 336. Linguistic Theory and Methods
393. Individual Research in Anthropology
402. Interdisciplinary Seminar in the History of the Social Sciences
410. Seminar in the Government. History. and Social Structure of India and Pakistan

Art

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of at least one foreign language (preferably German) is required. candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

Professors

Dario Covi, Ph.D. (New York). *Chairman and Director of Graduate Studies*; Louise Hall, Ph.D. (Radcliffe); William S. Heckscher. Ph.D. (Hamburg); *Benjamin N. Duke Professor of Art;* Marianna Jenkins, Ph.D. (Bryn Mawr); Sidney David Markman. Ph.D. (Columbia); Earl George Mueller, Ph.D. (Iowa State); Elizabeth Read Sunderland, Ph.D. (Radcliffe).

Lecturer

Karla Langedijk, Ph.D. (Amsterdam).

Courses of Instruction

217. Aegean Art
218. Early Greek Art
*233. Early Mediaeval Architecture
*234. Romanesque Sculpture
237. French Renaissance Art
238. Sienese Painting
239. Architecture of Britain
240. Architecture of North America
241. Problems in Latin American Art
247. Problems in the History of Graphic Arts
248. Studies in Florentine Painting
251-252. Research
253. Studies in Italian Renaissance Sculpture
255, 256. Iconological Problems
291, 292. Museology Seminar
293, 294. Special Problems in Art History
399. Directed Reading and Research

*Offered upon demand

Asian Languages

200-201. Special Studies in South Asian Languages: Hindi-Urdu

Biochemistry

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcomed, but adequate preparation in chemistry is essential. Graduate specilization areas include protein structure and synthesis, enzyme action, and metabolism.

Professors

Irwin Fridovich, Ph.D. (Duke); Samson R. Gross, Ph.D. (Columbia), *Director of the Genetics Division;* Walter R. Guild, Ph.D. (Yale); Philip Handler,* Ph.D. (Illinois); Robert Hill, Ph.D. (Kansas), *Chairman;* Henry Kamin, Ph.D. (Duke); Norman Kirshner, Ph.D. (Pennsylvania State), *Director of Graduate Studies;* Kenneth S. McCarty, Ph.D. (Columbia); Charles Tanford, Ph.D. (Princeton), *James B. Duke Professor of Physical Biochemistry.*

*On leave of absence.

Associate Professors

Stanley H. Appel, M.D. (Columbia); Ronald C. Greene, Ph.D. (California Institute of Technology); Jerome S. Harris, M.D. (Harvard); Bernard Kaufman, Ph.D. (Indiana); William Sanford Lynn, M.D. (Columbia); K. V. Rajagopalan, Ph.D. (University of Madras); Harvey J. Sage, Ph.D. (Yale); Robert E. Webster, Ph.D. (Duke).

Assistant Professors

Robert Bell, Ph.D. (California at Berkeley); Robert L. Habig, Ph.D. (Purdue); Dwight H. Hall, Ph.D. (Purdue); Philip D. Harriman, Ph.D. (California at Berkeley); William N. Kelley, M.D. (Emory); Sung-Hou Kim, Ph.D. (Pittsburgh); Nicholas M. Kredich, M.D. (Michigan); P. A. McKee, M.D. (Oklahoma); Jacqueline A. Reynolds, Ph.D. (Washington Univ.); David C. Richardson, Ph.D. (MIT); Lewis M. Siegel, Ph.D. (Johns Hopkins); James B. Sullivan, Ph.D. (Texas); Robert W. Wheat, Ph.D. (Washington Univ.).

Associates

John A. Bittikofer, Ph.D. (Purdue); Joseph Bonaventura, Ph.D. (Texas); Joe M. McCord, Ph.D. (Duke); Yasuhiko Nozaki, Ph.D. (Tokyo Univ.); Howard Steinman, Ph.D. (Yale).

Courses of Instruction

204. Introductory Genetics
208. Laboratory Methods in Biochemistry
209-210. Independent Study
216. Molecular Genetics
219. Molecular and Cellular Basis of Development
219L. Laboratory
219S. Seminar
222. Protein Crystallography
241. General Biochemistry
247. Introductory Biochemistry
276. Comparative and Evolutionary Biochemistry
282. Experimental Genetics
284. Current Topics in Genetic Mechanisms
286. Current Topics in Immunochemistry
288. The Carbohydrates and Lipids of Biological Systems
290. Bioenergetics
293. Macromolecules
294. Nucleic Acids and Macromolecular Synthesis
295. Enzyme Mechanisms
296. Biological Oxidations
297. Intermediary Metabolism
298. Regulation of Cellular Metabolism
345, 346. Biochemistry Seminar
351, 352. Genetics Seminar
390. Biochemistry of Membranes
395. Biochemical Pharmacology

Botany

Graduate work in the Department of Botany is offered leading to the A.M. and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

Professors

Lewis Edward Anderson, Ph.D. (Pennsylvania); William Dwight Billings, Ph.D. (Duke), *James B. Duke Professor of Botany;* William Lewis Culberson, Ph.D. (Wisconsin); Henry Hellmers, Ph.D. (California at Berkeley); Terry W. Johnson, Ph.D. (Michigan); Paul Jackson Kramer, Ph.D. (Ohio State), *James B. Duke Professor of Botany;* Aubrey Willard Naylor, Ph.D.

(Chicago), *James B. Duke Professor of Botany;* Jane Philpott, Ph.D. (State Univ. of Iowa); Donald E. Stone, Ph.D. (California at Berkeley); Robert L. Wilbur, Ph.D. (Michigan), *Chairman.*

Associate Professors

Janis Antonovics, Ph.D. (Wales); Richard T. Barber, Ph.D. (Stanford); John E. Boynton, Ph.D. (California at Davis); Kenneth R. Knoerr, Ph.D. (Yale); Richard B. Searles, Ph.D. (California at Berkeley); Boyd R. Strain, Ph.D. (California at Los Angeles), *Director of Graduate Studies;* Richard A. White, Ph.D. (Michigan).

Assistant Professor

William F. Blankley, Ph.D. (California at San Diego).

Lecturer

C. F. Culberson, Ph.D. (Duke).

Courses of Instruction

203. Cytogenetics
203L. Laboratory in Cytogenetics
205. Anatomy
S205. Introductory Marine Microbiology
209. Lichenology
210. Bryology
S211. Marine Phycology
212. Phycology
221. Mycology
225, 226. Special Problems
242. Systematics
245. Plant Diversity
246. Ecology
248. Introductory Biochemistry
250. Plant Biosystematics
251. Physiology
252. Plant Metabolism
254. Plant-Water Relations
255. Plant Systematics

Business Administration

The Graduate School of Business Administration offers work leading to the M.B.A., Ph.D., and the M.S. in Management Sciences. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate for rigorous analysis. Normally, undergraduate majors in such fields as the physical and biological sciences, mathematics, engineering, and the social sciences are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The doctoral level course work presumes either a Duke M.B.A. or the equivalent. One year of study (30 semester hours) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, one course in philosophy of science, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

Professors

Helmy H. Baligh, Ph.D. (California at Berkeley); Thomas F. Keller, Ph.D. (Michigan); Louis D. Volpp, Ph.D. (State Univ. of Iowa).

Associate Professors

Joseph Battle, Ph.D. (Michigan); Richard M. Burton, D.B.A. (Illinois); David C. Dellinger, Ph.D. (Stanford); Danny J. Laughhunn, D.B.A. (Illinois); Louis R. Pondy, Ph.D. (Carnegie Institute of Technology).

Assistant Professors

Carole A. Aldrich, Ph.D. (Carnegie-Mellon); William W. Damon, Ph.D. (Cornell); Robert

Hagerman, Ph.D. (Rochester); Arthur J. Kuhn, Ph.D. (California at Berkeley); Steven F. Maier, Ph.D. (Stanford); Russell J. Petersen, Ph.D., C.P.A. (Washington).

Courses of Instruction for the M.B.A.

First Year Requirements

300-301. Managerial Theory of the Firm
310. Foundations for Quantitative Analysis I
311. Foundations for Ouantitative Analysis II
320. Management of Information and Control Systems I
321. Management of Information and Control Systems II
330, 331. Organization Theory and Management
341. Macroeconomic Analysis

Second Year Requirements

302. Cooperative Decisions and Competitive Strategies
303. Cooperative-Competitive Relations and Decisions
312. Operations Research
332. Organization Design and Internal Operations
349. Law as a Constraint for Business
350. Public Policy of the Firm
390. The Practicum

Electives

313. Advanced Operations Research
323. Controllership
324. External Reporting and Auditing
333. Manpower Planning and Management
351. Finance
353. Marketing
355. Production

Courses for the M.S. in Management Sciences

300. Managerial Economics
302. Planning and Internal Organization
310. Mathematics for Management
311. Probability and Statistics
312. Operations Research
320. Organization Analysis and Operation Design
330. Accounting and Control Systems
340. Controllership
341. Marketing Management
342. Financial Management
343. Production Management
344. Human Resource Management
350. Social Issues and the Complex Organization
390. Practicum

Chemistry

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields. A booklet providing detailed information on the department is available from the Director of Graduate Studies.

Professors

Charles Kilgo Bradsher, Ph.D. (Harvard), *James B. Duke Professor;* Frances Campbell Brown, Ph.D. (Johns Hopkins); Donald B. Chesnut, Ph.D. (California Institute of Technology), *Director of Graduate Studies;* Marcus Edwin Hobbs, Ph.D. (Duke); Peter W. Jeffs, Ph.D. (Natal); William R. Krigbaum, Ph.D. (Illinois), *James B. Duke Professor;* William E. Parham, Ph.D. (Illinois), *R. J. Reynolds Company Professor of Chemistry;* Jacques C. Poirier, Ph.D. (Chicago); Louis DeBose Ouin, Ph.D. (North Carolina), *Chairman;* Peter Smith, Ph.D. (Cambridge); Howard Austin Strobel, Ph.D. (Brown); Pelham Wilder, Jr., Ph.D. (Harvard).

Associate Professors

Andrew T. McPhail, Ph.D. (Glasgow); Richard A. Palmer, Ph.D. (Illinois); Richard L. Wells, Ph.D. (Indiana).

Assistant Professors

Rodger W. Baier, Ph.D. (Washington); Steven Baldwin, Ph.D. (California Institute of Technology); Alvin L. Crumbliss, Ph.D. (Northwestern); William Gutknecht, Ph.D. (Purdue); Robert W. Henkens, Ph.D. (Yale); Charles H. Lochmuller, Ph.D. (Fordham); Ned Allen Porter, Ph.D. (Harvard).

Adjunct Professor

Anton Peterlin, Ph.D. (Univ. of Berlin).

Adjunct Associate Professors

Robert G. Ghirardelli, Ph.D. (California Institute of Technology); Colin G. Pitt, Ph.D. (London); David Rosenthal, Ph.D. (MIT); Bernard F. Spielvogel, Ph.D. (Michigan).

Courses of Instruction

201. Molecular Spectroscopy
203. Quantum Chemistry
205. Structure and Reaction Dynamics
207. Principles of Thermodynamics, Diffraction, and Kinetics
240. Chemical Oceanography
300. Basic Statistical Mechanics
302. Basic Quantum Mechanics
303, 304. Special Topics in Physical Chemistry
310. Theoretical and Structural Inorganic Chemistry
312. Inorganic Reactions and Mechanisms
313, 314. Special Topics in Inorganic Chemistry
320. Synthetic Organic Chemistry
322. Organic Reactive Intermediates
323, 324. Special Topics in Organic Chemistry
330. Chemical Separation Methods and Kinetics in Analytical Chemistry
331, 332. Special Topics in Analytical Chemistry
334. Chemical Instrumentation and Applied Spectroscopy
373, 374. Seminar
375, 376. Research
377. Research Orientation Seminar

Classical Studies

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archaeology. For regular admission to the program in literature and philology a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information in the detailed official *Bulletin of the Graduate School* are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements on seminars, course work, and the preliminary examination for the Ph.D. degree.

Professors

Francis Newton, Ph.D. (North Carolina), *Director of Graduate Studies;* John F. Oates, Ph.D. (Yale), *Chairman;* Lawrence Richardson, Jr., Ph.D. (Yale), F.A.A.R.; James N. Truesdale, Ph.D. (Duke); William H. Willis, Ph.D. (Yale).

Associate Professor

Dennis Keith Stanley, Ph.D. (Johns Hopkins).

Assistant Professors

Peter H. Burian, Ph.D. (Princeton); Charles Edwin V. Nixon, Ph.D. (Michigan); Kent J. Rigsby, Society of Fellows (Harvard).

GREEK

Courses of Instruction

200. Graduate Reading
203. Homer
*205. Greek Lyric Poets
*206. Aeschylus
*208. Sophocles
209. Euripides
*210. Aristophanes
*221. Early Greek Prose
*222. Thucydides
*223. Greek Orators I
*224. Greek Orators II
*225. Plato
*231. Hellenistic Poetry
241. Advanced Prose Composition
301. Greek Seminar I
302. Greek Seminar II
303. Greek Seminar III
304. Greek Seminar IV
305. Greek Seminar V
306. Greek Seminar VI
311. Proseminar in Papyrology
313. Proseminar in Greek Epigraphy
321. Seminar in Literary Papyri
323. Seminar in Documentary Papyri
399. Directed Reading and Research

*Not offered in 1973-74.

LATIN

200. Graduate Reading
*201. The Verse Treatise
*202. Roman Satire
203. Epic: Vergil
204. Epic: Lucan and Statius
*207. The Prose Epistle
*208. The Epistle in Verse
*209. Fragments of Early Latin
*210. Lyric and Occasional Poetry
*211. Roman Oratory I
*212. Roman Oratory II
*221. Mediaeval Latin I
*222. Mediaeval Latin II
*241. Advanced Latin Composition
301. Latin Seminar I
302. Latin Seminar II
303. Latin Seminar III
304. Latin Seminar IV
305. Latin Seminar V
306. Latin Seminar VI
312. Proseminar in Latin Palaeography
314. Proseminar in Latin Epigraphy
315. Proseminar in Roman Law
399. Directed Reading and Research

*Not offered in 1973-74.

CLASSICAL STUDIES

301. Introduction to Classical Philology

CLASSICAL STUDIES (ANCIENT HISTORY)

*253. Greece to the Orientalizing Period
*254. The Age of the Tyrants and the Persian Wars
*255. The Age of Pericles
*256. The Fourth Century through Alexander
*257. Social and Cultural History of the Hellenistic World from Alexander to Augustus
*258. Social and Cultural History of the Graeco-Roman World
*260. The History of Rome to 146 B.C.
*261. The Roman Revolution, 146-30 B.C.
*262. Rome under the Julio-Claudians
*263. From the Flavian Dynasty to the Severan
*264. From Septimius Severus to Constantine
*270. The Rise of the Hellenistic Kingdoms
*271. The Hellenistic Kingdoms 250-31 B.C.
321. Seminar in Ancient History I
322. Seminar in Ancient History II
323. Seminar in Ancient History III
324. Seminar in Ancient History IV
325. Seminar in Ancient History V
326. Seminar in Ancient History VI
399. Directed Reading and Research

*Not offered in 1973-74.

CLASSICAL STUDIES (ARCHAEOLOGY)

*231. Greek Sculpture
232. Greek Painting
*235. Roman Architecture
*236. Roman Painting
311. Archaeology Seminar I
312. Archaeology Seminar II

*Not offered in 1973-74.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve in the minor programs of students in other departments. Consult Professor Salinger, Department of Germanic Languages and Literature.

201, 202. Romanticism
203, 204. Realism and Symbolism
205. Foundations of Twentieth-Century European Literature
213. The Slavs: Literature and Culture, 1918-1939
214. The Slavs: Literature and Culture, 1940-1970
301. The Hero in European Fiction, 1830-

Computer Science

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees. A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and differential equations and at least two computer programming languages. The research areas currently active within the program include compiler design, real-time computing, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

Professors

Thomas M. Gallie, Ph.D. (Rice), *Director of Graduate Studies;* Peter N. Marinos, Ph.D. (North Carolina State); Thomas H. Naylor, Ph.D. (Tulane); Loren Nolte, Ph.D. (Michigan); Max A. Woodbury, Ph.D. (Michigan).

Associate Professors

William E. Hammond, Ph.D. (Duke); Merrell L. Patrick, Ph.D. (Carnegie Institute of Technology), *Acting Chairman;* Charles Starmer, Ph.D. (North Carolina).

Assistant Professor

Dietolf Ramm, Ph.D. (Duke).

Instructor

Joseph Austin, B.S. (St. Louis Univ.).

Adjunct Associate Professor

Leland Williams, Ph.D. (Duke).

Courses of Instruction

203. Random Signals and Noise
205. Signal Detection and Extraction Theory
208. Digital Computer Design
210. Image Processing
211. Control Programs in Operating Systems
212. Advanced Topics in Control Programs
215. Artificial Intelligence
221. Numerical Analysis I
222. Numerical Analysis II
223. Numerical Analysis III
231. Introduction to Operating Systems
232. Metaprograms
241, 242. Information Organization and Retrieval
244. Econometrics II
250. Clustering and Classification
251. Computer Science for Teachers
265. Advanced Topics in Computer Science
306. Adaptive Detection and Communication Systems
307. Advanced Digital Systems I
308. Advanced Digital Systems II
311. Inverse Biomedical Models
321. Topics in Numerical Mathematics
344. Workshop on Computer Models of Social Systems
350. Advanced Engineering Analysis

Economics

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. A student entering graduate work in economics should have completed with satisfactory grades at least 12 semester hours of undergraduate work in economics, including 6 hours of principles of economics. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics.

Requirements for the Ph.D. in economics include an examination in economic theory at the end of the first year, and at the end of the second year examinations in three additional fields. The student may select these from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the Economics Department (e.g., demography). Course work for the Ph.D. should be completed in four semesters of residence.

Professors

John Oliver Blackburn, Ph.D. (Florida); Martin Bronfenbrenner, Ph.D. (Chicago), *William R. Kenan, Jr. Professor of Economics;* David George Davies, Ph.D. (California at Los Angeles), *Chairman;* Frank Traver de Vyver, Ph.D. (Princeton); Craufurd David Goodwin, Ph.D. (Duke); Frank Allan Hanna, Ph.D. (Wisconsin); Allen C. Kelley, Ph.D. (Stanford); Juanita Morris Kreps, Ph.D. (Duke), *James B. Duke Professor of Economics;* Thomas Herbert Naylor, Ph.D. (Tulane); Lloyd Blackstone Saville, Ph.D. (Columbia); Vladimir G. Treml, Ph.D. (North Carolina); John M. Vernon, Ph.D. (MIT); William Poe Yohe, Ph.D. (Michigan).

Associate Professors

Henry Grabowski, Ph.D. (Princeton); Thomas M. Havrilesky, Ph.D. (Illinois); Eliot Roy Weintraub, Ph.D. (Pennsylvania), *Director of Graduate Studies.*

Assistant Professors

David E. Black, Ph.D. (MIT); Neil de Marchi, Ph.D. (Australian National Univ.); Daniel A. Graham, Ph.D. (Duke); Marjorie McElroy, Ph.D. (Northwestern); Jay S. Salkin, Ph.D. (Northwestern).

Courses of Instruction

204. Advanced Money and Banking
231. Economic Development of Europe
*233. State and Urban Finance
237, 238. Statistical Methods
243. Econometrics I
244. Econometrics II
262. Trade Unionism and Collective Bargaining
265. International Trade and Finance
268. Competition and Monopoly
287. Public Finance
293. Soviet Economic History
294. Soviet Economic System
301. Microeconomic Analysis I
302. Microeconomic Analysis II
303. Theory of Economic Decision-Making
304, 305. Seminar in Money and Banking
307. Quantitative Analysis I
308. Quantitative Analysis II
311, 312. History of Political Economy
313, 314. Seminar in Economic Theory
316. Seminar in Economics of Soviet-Type Socialism
317. Seminar in Demographic, Population, and Resource Problems
318. Dissertation Seminar
319. Seminar in the Theory and the Problems of Economic Growth and Change
320. Macroeconomic Analysis I
321. Theory of Quantitative Economic Policy
322. Macroeconomic Analysis II
323. Income Distribution Theory
329. Federal Finance
330. Seminar in Public Finance
331. Seminar in Economic History
*340. National Income
344. Workshop on Computer Models of Social Systems
345, 346. Demographic Techniques I and II
350. Seminar in Applied Economics
355. Seminar in Labor Economics
358. Seminar in Labor Market and Related Analysis
365. Seminar in International Economics
366. Monetary Aspects of International Trade and Finance
*388. Industrial Organization
*389. Seminar in Industrial and Governmental Problems
397, 398. Directed Research
401. Seminar on the British Commonwealth
402. Interdisciplinary Seminar in the History of the Social Sciences

*Offered on demand.

Education

Graduate work in education is offered leading to the A.M., M.Ed., M.A.T., Ed.D., and Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in the official detailed *Bulletin of the Graduate School*. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the advanced Principal's Certificate and the Superintendent's Certificate. (Some courses below are offered only in the summer session, see the *Bulletin of the Summer Session.)*

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctor's degree as the highest degree approved.

Professors

William H. Cartwright, Ph.D. (Minnesota); W. Scott Gehman, Jr., Ph.D. (Pennsylvania), Sherwood Githens, Jr., Ph.D. (North Carolina); Everett H. Hopkins, M.A. (Wittenburg), Allan S. Hurlburt, Ph.D. (Cornell), *Chairman;* Olan Lee Petty, Ph.D. (Iowa); R. Baird Shuman, Ph.D. (Pennsylvania); Henry Weitz, Ed.D. (Rutgers).

Associate Professors

Anne H. Adams, Ed.D. (Mississippi); Robert H. Ballantyne, Ed.D. (Washington State); Peter F. Carbone, Ed.D. (Harvard), *Director of Cooperative Programs;* Robert Merle Colver, Ed.D. (Kansas); Lucy T. Davis, Ed.D. (Columbia); Joseph Di Bona, Ph.D. (California at Berkeley); Anne Flowers, Ed.D. (Duke); Charles B. Johnson, Ed.D. (Duke), *Director of Graduate Studies;* William G. Katzenmeyer, Ed.D. (Duke); David V. Martin, Ed.D. (Duke); Robert A. Pittillo, Jr., Ed.D. (Duke); Henry L. Sublett, Ed.D. (Virginia).

Adjunct Professor

J. A. Davis, Ph.D. (Columbia).

201. Teaching and Supervision of Arithmetic
202. Comparative and International Education: Industrialized Nations
204. Educational Organization
206. Studies in the History of Educational Philosophy
207. Social History of Twentieth-Century American Education
211. The Problem Child
*213. Elementary-School Organization and Administration
215. Secondary Education: Principles
216. Secondary Education: Internship
217. The Psychological Principles of Education
218. Comparative and International Education: Developing Societies
219. Comparative and International Education: South Asia
221. Programs in Early Childhood Education
222. New Developments in Elementary School Curriculum
*223. Teaching the Language Arts
225. The Teaching of History and the Social Sciences
226. Teaching Reading in the Elementary School
227. The Teaching of Geography
229. Formal and Informal Classroom Diagnosis of Reading Disability Cases
233. Improvement of Instruction in English
234. Secondary-School Organization and Administration
236. Teaching Reading in the Secondary Schools
237. The Teaching of Literature in Secondary Schools
238. Content, Supervision, and Administration of Reading Programs
239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary Schools
240. Career Development
241. Principles of Guidance and Student Personnel Work
243. Personality Dynamics
244. Counseling Techniques
245. Theories of Counseling
246. The Teaching of Mathematics
247. Practicum in Guidance and Counseling
248. Practicum in Counseling
249. Exceptional Children
250, 251. Teaching Emotionally Disturbed Children: Internship
*252. The School in the Legal Structure
253. Law and Education
255. Assessment of Abilities
256. Classroom Assessment of Student Achievement
258. Assessment of Personality, Interests, and Attitudes
260. Introduction to Educational Research
261. Intermediate Educational Research
*266. Science in the Elementary School
268. Seminar in Contemporary Educational Criticism
270. The Junior College
272. Teaching Communication Skills in Early Childhood Education
273, 274. Clinical Reading Practicum
276. The Teaching of High-School Science
300. Individual Assessment of Intelligence
302. Seminar in Educational Research
306. Seminar in Philosophical Analysis of Educational Concepts
311. Group Counseling
313. Seminar in Education and Public Policy
314. Seminar in Guidance and Counseling
315. Seminar in Secondary-School Teaching
321. Educational Management
322. Planning and Management of Educational Facilities
*323. Public School Finance
332. Supervision of Instruction
333. Seminar in Higher Education
335, 336. Seminar in School Administration
337. Seminar in Community College Organization
338. Seminar in Educational Supervision
339. Seminar in Curriculum
340. Seminar in Social Studies Curriculum
341. Seminar in Elementary School Curriculum
342. Seminar in Secondary School Curriculum
343. History of Higher Education in America
344. Research in Higher Education
345. Seminar in Reading Instruction and Research

*Offered on demand.

Engineering

George Wilbur Pearsall, Sc.D., *Dean*

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the science of engineering, which is based on mathematics and the physical sciences, and to develop experience in the art of engineering, which depends on human imagination and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A minimum of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (normally mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A nonthesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A minimum of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (normally mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation. In mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. A reading knowledge of one foreign language which is relevant to the field of the dissertation is required (normally French, German, or Russian) in civil engineering, but may be waived under certain circumstances. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics, biomedical materials, biomedical modeling, data acquisition and processing, and electrophysiology.

Professors

Peter B. Bennett, Ph.D. (South Hampton); Loren Nolte, Ph.D. (Michigan); Theo Clyde Pilkington, Ph.D. (Duke), *Chairman;* Frederick L. Thurstone, Ph.D. (North Carolina State), *Director of Graduate Studies;* Myron Wolbarsht, Ph.D. (Johns Hopkins).

Associate Professors

Roger Barr, Ph.D. (Duke); Howard Clark, Ph.D. (Maryland); William E. Hammond, Ph.D. (Duke); Brian A. Hills, Ph.D. (Adelaide); Howard C. Wachtel, Ph.D. (New York Univ.).

Courses of Instruction

201. Introductory Biomedical Engineering I
202. Introductory Biomedical Engineering II
223. Biomedical Materials and Artificial Organs
265. Advanced Topics in Biomedical Engineering
311. Inverse Biomedical Models
333. Biomedical Imaging
399. Special Readings in Biomedical Engineering

CIVIL ENGINEERING

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree with a major in civil engineering: engineering mechanics, structural engineering, soil mechanics and geotechnical engineering, fluid mechanics and ocean engineering, materials science and engineering, environmental engineering, urban systems and transportation engineering. Programs combining study in some of these areas with business administration, social sciences, and other areas of engineering are also available. Each graduate student participates in seminars appropriate to his field of study.

Under the Reciprocal Agreement with Neighboring Universities, a student may include, as a portion of the minimum requirements, work offered by the Department of Environmental Science and Engineering of the University of North Carolina. Although minor work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social sciences may take relevant minor work in this area.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

Professors

Earl I. Brown, Ph.D. (Texas), *J. A. Jones Professor of Civil Engineering;* Senol Utku, Sc.D. (MIT); Aleksandar Sedmak Vesic, D.Sc. (Belgrade), *J. A. Jones Professor of Civil Engineering and Chairman.*

Associate Professors

J. Dvorak, Ph.D. (Brown); Bruce J. Muga, Ph.D. (Illinois), *Director of Graduate Studies;* Aubrey E. Palmer, C. E. (Virginia); James F. Wilson, Ph.D. (Ohio State).

Assistant Professors

G. Wayne Clough, Ph.D. (California at Berkeley); Jarir Dajani, Ph.D. (Northwestern); P. Aarne Vesilind, Ph.D. (North Carolina).

Courses of Instruction

201. Advanced Mechanics of Solids
202. Experimental Mechanics
*203. Elastic Stability
*204. Plates and Shells
205. Elasticity
210. Intermediate Dynamics
211. Mechanical Behavior of Materials
217. Urban Systems Analysis
*221. Incompressible Fluid Flow
222. Open-Channel Flow
223. Flow Through Porous Media
*224. Coastal and Offshore Engineering
225. Engineering Hydrology
230. Matrix Methods for Structural Analysis
231. Structural Engineering Analysis
232. Reinforced Concrete Design
*233. Prestressed Concrete Design
234. Structural Design in Metals
*235. Foundation Engineering
236. Earth Structures
243, 244. Sanitary Engineering Unit Operations and Process Design
247. Air Pollution Control
248. Solid Waste Management
250. Engineering Analysis
*304. Advanced Plates and Shells
*305. Advanced Elasticity
*306. Plasticity
307. Viscoelasticity
309. Advanced Dynamics
*321. Mechanics of Ideal Fluids
331. Advanced Structural Analysis I
332. Advanced Structural Analysis II
335. Mechanical Behavior of Soils
336. Advanced Soil Mechanics
337. Elements of Soil Dynamics
338. Rock Mechanics
350. Advanced Engineering Analysis
365. Advanced Topics in Civil Engineering
399. Special Readings in Civil Engineering

*Not offered in 1973-74.

ELECTRICAL ENGINEERING

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree: solid-state materials and devices, ferromagnetics, super-conducting circuits, instrumentation, electronics, microwaves and automatic control, energy conversion, digital systems, stochastic systems, and information processing.

A minimum prerequisite to the graduate courses in electrical engineering is a basic knowledge of differential equations, electric and magnetic field theory, and the theory of networks. A previous course in modern physics is recommended. There is no foreign language requirement. A qualifying examination is required for the Ph.D. program.

Professors

John Leslie Artley, D.Eng. (Johns Hopkins); Robert Blackburn Kerr, D.Eng. (Johns Hopkins); Peter N. Marinos, Ph.D. (North Carolina State); Loren W. Nolte, Ph.D. (Michigan); Harry Ashton Owen, Jr., Ph.D. (North Carolina State), *Chairman;* Theo Clyde Pilkington, Ph.D. (Duke); Frederick L. Thurstone, Ph.D. (North Carolina State); Thomas George Wilson, Sc.D. (Harvard).

Associate Professors

Herbert Hacker, Ph.D. (Michigan), *Director of Graduate Studies;* William Thomas Joines, Ph.D. (Duke); Paul P. Wang, Ph.D. (Ohio State).

Assistant Professor

Rhett Truesdale George, Ph.D. (Florida).

Courses of Instruction

203. Random Signals and Noise
204. Information Theory and Communication Systems
205. Signal Detection and Extraction Theory
208. Digital Computer Design
211. Solid State Theory
212. Solid State Materials
*213. Principles of Magnetism
*215. Semiconductor Physics
217. Masers
222. Nonlinear Analysis
225. Semiconductor Electric Circuits
227. Network Synthesis
242. Modern Control and Dynamic Systems
243. Advanced Linear Systems Theory
*259. Advanced Electric Energy Conversion
265. Advanced Topics in Electrical Engineering
271. Electromagnetic Theory
272. Applications of Electromagnetic Theory
297-298. Thesis Research
304. Estimation, Filtering, and Random Systems
305. Advanced Applications of Statistical Decision Theory
306. Adaptive Detection and Communication Systems
307. Advanced Digital Systems I
308. Advanced Digital Systems II
*311. Quantum Theory of Materials
*313. Magnetic Processes in Materials
321. Nonlinear Magnetic and Semiconductor Circuits
324. Nonlinear Oscillations in Physical Systems
342. Optimal Control Theory
345. Stochastic Control Systems
361, 362. Electrical Engineering Seminar-Journal
371. Advanced Electromagnetic Theory
373. Selected Topics in Field Theory
399. Special Readings in Electrical Engineering

*Offered on demand.

MECHANICAL ENGINEERING

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in mechanical engineering. Departmental programs of advanced study and research include control systems, dynamics and vibrations, fluid mechanics, heat and mass transport, mechanical design, metallurgy, polymer science, and thermodynamics. The mechanical engineering faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in the areas which include applied mechanics, biomechanics, biomedical materials, energy conversion, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, and transportation systems.

Professors

Jack Bartley Chaddock, Sc.D. (MIT), *Chairman;* Devendra P. Garg, Ph.D. (New York Univ.); Charles Morgan Harman, Ph.D. (Wisconsin); Van Leslie Kenyon, Jr., M.M.E. (Delaware); L. Sigfred Linderoth, M.E. (Iowa State); John Nelson Macduff, M.M.E. (New York Univ.) George Wilbur Pearsall, Sc.D. (MIT).

Associate Professors

Howard G. Clark, Ph.D. (Maryland); Franklin H. Cocks, Ph.D. (MIT); Ernest Elsevier, M.S.M.E. (Georgia Institute of Technology); Marion LaVerne Shepard, Ph.D. (Iowa State).

Assistant Professors

Gale Herbert Buzzard, Ph.D. (North Carolina State), *Director of Graduate Studies;* Bruce R. Munson, Ph.D. (Minnesota); Donald Wright, Ph.D. (Purdue).

Courses of Instruction

202. Theoretical Thermodynamics
210. Intermediate Dynamics
211. Theoretical and Applied Polymer Science
214. Environmental Factors in Materials Science
215. Failure Analysis and Prevention
221. Compressible Fluid Flow
222. Heat Transfer
226. Intermediate Fluid Mechanics
230. Modern Control and Dynamic Systems
231. Systems Response and Control
232. Nonlinear Analysis
233. Fluid Control Systems
235. Advanced Mechanical Vibrations
251. Refrigeration and Cryogenics
255. Energy Conversion
265. Advanced Topics in Mechanical Engineering
270. Theory of Lubrication and Bearing Design
280. Nuclear Reactor Power Cycles
300. Advanced Projects in Mechanical Engineering
302. Advanced Thermodynamics
309. Advanced Dynamics
311. Behavior of Crystalline Solids
322. Mechanics of Viscous Fluids
323. Convective Heat Transfer
324. Conduction and Radiation Heat Transfer
326. Hydrodynamic Stability
331. Nonlinear Control Systems
333. Seminar in Control Systems
335. Analytic Methods in Vibrations
372. Finite Element Techniques in Design
399. Special Readings in Mechanical Engineering

English

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the Ph.D. degree may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one modern foreign language for the A.M. degree and two languages, determined by the student's committee, for the Ph.D. degree.

Professors

Carl Anderson, Ph.D. (Pennsylvania); Louis J. Budd, Ph.D. (Wisconsin); Bernard I. Duffey, Ph.D. (Ohio State); Oliver W. Ferguson, Ph.D. (Illinois), *Chairman;* John L. Lievsay, Ph.D. (Washington), *James B. Duke Professor of English;* Holger O. V. Nygard, Ph.D. (California), *Director of Graduate Studies;* Dale Randall, Ph.D. (Pennsylvania); Edmund Reiss, Ph.D. (Harvard); Clyde de Loache Ryals, Ph.D. (Pennsylvania); Charles Richard Sanders, Ph.D. (Chicago); Grover C. Smith, Ph.D. (Columbia); Arlin Turner, Ph.D. (Texas); George W. Williams, Ph.D. (Virginia).

Associate Professors

John Clubbe, Ph.D. (Columbia); Gerald E. Gerber, Ph.D. (Northwestern); Wallace Jackson, Ph.D. (Pennsylvania); Buford Jones, Ph.D. (Harvard); Robert Krueger, D.Phil. (Oxon); Elgin Mellown, Ph.D. (London); Gerald Monsman, Ph.D. (Johns Hopkins); Victor H. Strandberg, Ph.D. (Brown).

Assistant Professors

Ronald Richard Butters, Ph.D. (Iowa); A. Leigh DeNeef, Ph.D. (Pennsylvania State).

Courses of Instruction

207, 208. History of the English Language
209. Present-Day English
210. Old English Literary Tradition
212. Middle English Literary Tradition
215, 216. Chaucer
221. English Prose of the Sixteenth Century
222. English Non-Dramatic Poetry of the Sixteenth Century
223. Spenser
224. Shakespeare
225, 226. Tudor and Stuart Drama, 1500-1642
229, 230. English Literature of the Seventeenth Century
232. Milton
234. English Drama, 1642-1800
235, 236. The Eighteenth Century
241, 242. English Literature of the Early Nineteenth Century
245, 246. English Literature of the Later Nineteenth Century
251, 252. English Literature of the Twentieth Century
263, 264. American Literature, 1800-1865
267, 268. American Literature, 1865-1910
270, 271. Southern Literature
275, 276. American Literature Since 1910
280. Introduction to Folklore
285. Literary Criticism
287. Recent Critical Thought
289. Literary Biography
310. Beowulf
312. Studies in Middle English Literature
315. Studies in Chaucer
318. Medieval Romances
320. Studies in Renaissance English Prose
324. Studies in Shakespeare
329. Studies in the Metaphysical Poets
330. Studies in Dryden and His Age
337. Studies in Swift
338. Samuel Johnson's Literary Criticism and Related Topics
339. The Eighteenth-Century Novel
341. Studies in English Romanticism
343. Studies in the Critical and Philosophical Ideas of Coleridge and Carlyle
347. Studies in Victorian Poetry
348. Studies in Victorian Fiction
349. Studies in Nineteenth-Century Nonfictional Prose
353. Studies in British Poetry of the Twentieth Century
361. Studies in a Major American Author of the Early Nineteenth Century
362. Studies in a Major American Author of the Later Nineteenth Century
364. Hawthorne and Melville
368. Studies in American Realistic Fiction

Forestry

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the A.M., M.S., and Ph.D. degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the *Bulletin of the School of Forestry* should be consulted.

Professors

Roger Fabian Anderson, Ph.D. (Minnesota), *Director of Graduate Studies;* Robert Lloyd Barnes, Ph.D. (Duke); Ellwood Scott Harrar, Ph.D., Sc.D. (Syracuse), *James B. Duke Professor of Wood Science;* Henry Hellmers, Ph.D. (California at Berkeley); Kenneth Richard Knoerr, Ph.D. (Yale); Paul Jackson Kramer, Ph.D. (Ohio State), *James B. Duke Professor of Botany;* Charles William Ralston, Ph.D. (Duke), *Dean of the School of Forestry;* William James Stambaugh, Ph.D. (Yale).

Associate Professor

David O. Yandle, Ph.D. (North Carolina State).

Adjunct Associate Professors

Edgar W. Clark, Ph.D. (California at Berkeley); Charles S. Hodges, Jr., Ph.D. (Georgia); Louis John Metz, Ph.D. (Duke); Fred M. Vukovich, Ph.D. (St. Louis).

Assistant Professors

Roger C. Chapman, M.A. (California at Berkeley); Frank J. Convery, Ph.D. (State Univ. of New York); James E. Wuenscher, Ph.D. (Wisconsin).

BIOLOGICAL SCIENCE

Courses of Instruction

201. Tree Physiology
205. Tree Growth and Development
207. Chemistry of Woody Tissues
208. Physiology of Wood Formation
222. Biology of Forest Insects and Diseases
223. Forest Pathology
225. Chemical Aspects of Forest Protection
230. Forest Entomology
233. General Entomology
241. Dendrology
243. Natural Resource Ecology
290. Wood Anatomy
292. Microtechnique of Woody Tissue
305. Forest Tree Biochemistry
321. Phytopathological Technique in Forestry
322. Microbiology of Forest Soils
331. Toxicology of Insecticides
332. Ecology of Forest Insects
335. Entomological Research Techniques
341. Ecological Principles in Environmental Management
345, 346. Natural Resource Ecology—Environmental Management Seminar
347, 348. Natural Resource Ecology—Environmental Management Seminar
354. Quantitative Analysis of Ecological Environmental Systems
385. Seminar in Forest Protection
398. Timbers of the World

ENVIRONMENTAL SCIENCE

203. General Meteorology
204. Microclimatology
215. Air Pollution Meteorology
216. Watershed Hydrology
217. Environmental Instrumentation
261. Forest Soils
304. Atmospheric Turbulence and Diffusion
306. Dynamics of Local Atmospheric Motion
342. Hydrologic Processes
344. Micrometeorology
362. Forest Soil Physics
364. Soil Classification and Mapping
366. Forest Soil Fertility

RESOURCE ECONOMICS AND POLICY

269. Resource Economics and Policy
270. Economics of Forestry
377. Seminar in Natural Resource Allocation and Efficiency
378. Seminar in Forest Economics

STATISTICS AND OPERATIONS RESEARCH

210. Analytical Techniques in Forest Utilization
250. Biometry
251. Theory and Methods for Sampling Biological Populations
253. Computer Science in Natural Resources
258. Operations Research
352. Theory and Applications of Linear Statistical Models
353. Design and Analysis of Experiments
354. Quantitative Analysis of Ecological and Environmental Systems

SPECIAL STUDIES AND RESEARCH

299. Special Studies in Forestry
301, 302. Advanced Studies in Forestry
357, 358. Research in Forestry
368. Field Seminars

The University Program in Genetics

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151).

Professors

D. Bernard Amos, M.D. (Guys Hospital, London); Samson R. Gross, Ph.D. (Columbia), *Director;* John Buettner-Janusch, Ph.D. (Michigan); Walter R. Guild, Ph.D. (Yale).

Associate Professors

Janis Antonovics, Ph.D. (Wales); John E. Boynton, Ph.D. (California at Davis); Nicholas Gillham, Ph.D. (Harvard); William N. Kelley, M.D. (Emory); Calvin L. Ward, Ph.D. (Texas); Robert E. Webster, Ph.D. (Duke).

Assistant Professors

Dwight H. Hall, Ph.D. (Purdue); Philip D. Harriman, Ph.D. (California at Berkeley); Nicholas Kredich, M.D. (Michigan); Ronald Luftig, Ph.D. (Chicago); Frances E. Ward, Ph.D. (Brown).

Courses of Instruction

204. Introductory Genetics
215. Bacteriophage: Structure and Function
216. Molecular Genetics
236. Human Genetics
280. Principles of Genetics
282. Experimental Genetics
284. Current Topics in Genetic Mechanisms
285. Population Genetics and Evolution
288. The Cell in Development and Heredity
336. Immunogenetics
351-352. Genetics Seminar (required of all students specializing in genetics)

Geology

The Department of Geology offers graduate work leading to the A.M. degree. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy. A thesis, but no language, is required for the A.M. degree.

Professor

S. Duncan Heron, Jr., Ph.D. (North Carolina), *Chairman.*

Associate Professors

William J. Furbish, M.S. (Wisconsin); George W. Lynts, Ph.D. (Wisconsin); Ronald D. Perkins, Ph.D. (Indiana), *Director of Graduate Studies;* Orrin H. Pilkey, Ph.D. (Florida State).

Adjunct Assistant Professor

Ian Macintyre, Ph.D. (McGill).

Courses of Instruction

205. Geological Oceanography
206. Principles of Geological Oceanography
208. Shallow-Marine Geology
211. Stratigraphic Principles and Applications
213. Sedimentology
214. Sediments in Thin Section
222. Sedimentary Minerals
*229. Economic Geology
230. Principles of Structural Geology
241-242. Invertebrate Paleontology
243-244. Micropaleontology

247. Paleoecology
*300. Seminar in Oceanography
305. Seminar in Continental Drift and Global Tectonics
*310. Seminar in Stratigraphy
*312. Seminar in Sedimentology
*320. Seminar in Mineralogy
*330. Seminar in Geochemistry
*340. Seminar in Paleontology
*350. Seminar in Geomathematics
*371, 372. Advanced Topics in Geology

*Offered on demand.

Germanic Languages and Literature

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect a major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second-year) of college German with acceptable grades.

Professors

Leland R. Phelps, Ph.D. (Ohio State), *Chairman and Director of Graduate Studies;* Herman Salinger, Ph.D. (Yale).

Associate Professor

Frank Borchardt, Ph.D. (Johns Hopkins).

Assistant Professors

A. Tilo Alt, Ph.D. (Texas); Richey Novak, Ph.D. (Johns Hopkins); Henry R. Stern, Ph.D. (Northwestern).

Courses of Instruction

201, 202. Goethe
203, 204. Eighteenth Century
*205, 206. Middle High German
*207, 208. German Romanticism
209, 210. Kleist, Grillparzer, and Hebbel
211, 212. Nineteenth-Century Literature
213. Heinrich Heine
214. The Twentieth Century
*215. Seventeenth-Century Literature
216. History of the German Language
*217. Renaissance and Reformation Literature
*218. The Teaching of German
*219. Applied Linguistics
*232. Criticism and Literary Theory
*233. Advanced Composition
*301. Gothic
*316. The Austrian Novel from 1930 to the Present
321, 322. Germanic Seminar

*Offered on demand.

Health Administration

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-one month academic program that leads to the M.H.A. degree. The academic portion is composed of five continuous semesters of graduate work of which 36 units are within the department, 39 units are in other departments of the Graduate School (30 of these units are in courses offered through the Graduate School of Business Administration).

Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study. As requirements for participation differ somewhat from the basic admission requirements of the Graduate School, interested individuals should obtain complete information about the program directly from the Chairman.

Associate Professors

Boi Jon Jaeger, Ph.D. (Duke), *Chairman;* Louis E. Swanson, A.B. (Hamline).

Assistant Professor

Donald S. Smith, II, M.H.A. (Minnesota), *Director of Graduate Studies.*

Adjunct Professor

John T. Gentry, M.D., M.P.H. (Harvard).

Adjunct Assistant Professor

Arnold D. Kaluzny, Ph.D. (Michigan).

Courses of Instruction

301. The Health System and Its Environment
312. Comparative Health Systems
322. Public Policy and Health Care
324. Institutional Health Services
329-339-349. The Practicum
335. Ambulatory Health Services
346. Community Health Services
348. Legal and Regulatory Constraints on Health Services
350. The Administrative Residency
360. Seminar in Health Administration
371, 372. Directed Research

History

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern language related to his program of study and have completed successfully either a research paper (approximately fifty to sixty documented pages) or two related, chapter-length papers (approximately twenty-five to thirty documented pages each), normally the product of a year's seminar or two semester-courses. The paper or papers must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three shall normally be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval Europe, early modern Europe, recent Europe, American history, English Renaissance, Modern Britain, British Empire and the Commonwealth, pre-revolutionary Russia, revolutionary Russia, Latin America, South Asia in the modern period, traditional China, modern China, traditional Japan, modern Japan, military history, history of science, history of medicine, and historiography. The candidate for the Ph.D. degree must normally have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative would normally take the form of successfully completed formal training in an auxiliary discipline (such as statistics or social science methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Students may receive credit for either semester of a hyphenated course without taking the other semester if they obtain written permission from the instructor and the Director of Graduate Studies.

Professors

John R. Alden, Ph.D. (Michigan), *James B. Duke Professor of History;* Joel Colton, Ph.D. (Columbia), *Chairman;* Robert F. Durden, Ph.D. (Princeton); Arthur B. Ferguson, Ph.D. (Cornell); Irving B. Holley, Jr., Ph.D. (Yale); Frederic Hollyday, Ph.D. (Duke); Warren Lerner, Ph.D. (Columbia); John F. Oates, Ph.D. (Yale); Harold T. Parker, Ph.D. (Chicago); Richard A. Preston, Ph.D. (Yale), *William K. Boyd Professor of History;* Theodore Ropp, Ph.D. (Harvard); Anne Firor Scott, Ph.D. (Radcliffe); William E. Scott, Ph.D. (Yale); Bernard S. Silberman, Ph.D. (Michigan); John J. TePaske, Ph.D. (Duke); Richard L. Watson, Ph.D. (Yale); Charles Young, Ph.D. (Cornell), *Director of Graduate Studies.*

Associate Professors

Frances Dorothy Acomb, Ph.D. (Chicago); Gert H. Brieger, M.D. (California at Los Angeles), Ph.D. (Johns Hopkins); John Cell, Ph.D. (Duke); Calvin D. Davis, Ph.D. (Indiana); Seymour Mauskopf, Ph.D. (Princeton); Ronald Witt, Ph.D. (Harvard).

Assistant Professors

William Chafe, Ph.D. (Columbia); Raymond Gavins, Ph.D. (Virginia); Lawrence C. Goodwyn, Ph.D. (Texas); Gerald Hartwig, Ph.D. (Indiana); Martin Miller, Ph.D. (Chicago); Sydney Nathans, Ph.D. (Johns Hopkins).

Courses of Instruction

201-202. History of Russia, 1801-1917
207-208. Urban History of the United States
209-210. Selected Topics in Afro-American History, 1619-Present
212. Recent Interpretations of United States History
215-216. The Diplomatic History of the United States
219. Historical and Contemporary African Society
221-222. Problems in the History of Late Medieval and Early Modern Europe
223-224. The Old Regime, the Enlightenment, and the French Revolution
227-228. Recent U.S. History: Major Political and Social Movements
229. Recent Interpretations of Modern European History
230. The History of Spain
231-232. The Hispanic Colonies and Republics in America
233-234. The Institutional, Cultural, and Social History of Hispanic America
237-238. Europe in the Middle Ages, 395-1500
240. Aspects of Traditional and Modern African Culture
241-242. Modernization and Revolution in China
247. History of Modern India and Pakistan, 1707-1857
248. History of Modern India and Pakistan, 1857 to the Present
249-250. Social and Intellectual History of the United States
253-254. Modern European Intellectual History
255-256. Problems in African History
261-262. Problems in Soviet History
263-264. American Colonial History and the Revolution 1607-1789
265-266. Modern South America
267-268. From Medieval to Early Modern England
269-270. British History, Seventeenth-Century to the Present
273, 274. Topics in the History of Science
275-276. Central Europe, 1849-1914
277-278. The Era of the Civil War in the United States and Its Aftermath, 1820-1900
279. Oral History
281-282. Development of Modern Medicine
283-284. Political and Social Change in the United States, 1789-1860
287-288. History of Modern Japan
290. East African History
296. Canada from the French Settlement to the Present
297. The British Empire in the Nineteenth Century (from 1783)
298. The Commonwealth in the Twentieth Century
305-306. Seminar in British History
307-308. Seminar in United States History
309-310. Seminar in American Colonial and Revolutionary History
317-318. Seminar in the History of Western Europe
337-338. Seminar in Medieval History
343-344. Seminar in the History of American Foreign Relations
347-348. Seminar in Modern India
353-354. Seminar on the Second British Empire and the Commonwealth of Nations
361-362. Seminar in the History of Russia
371-372. Research Seminars
401. Seminar on the British Commonwealth
351.1-352.1 Military History
351.2-352.2 Modern European Intellectual and Cultural History
351.10-352.10 Medieval Europe
351.15-352.15 The English Renaissance

351.25-352.25 Central Europe, 1849-1914
351.30-352.30 European Diplomatic History Since 1870
351.31-352.31 Twentieth-Century Europe
351.40-352.40 City and Frontier in United States History
351.45-352.45 Reform and Politics in Nineteenth-Century America
351.46-352.46 Twentieth-Century United States to 1941
351.47-352.47 Diplomatic History of the United States
351-51-352.51 Hispanic America
351.60-352.60 Soviet History
351.65-352.65 Modernization and Revolution in China
351.70-352.70 Modern South Asia
312. Seminar in the Teaching of History in College
314 Historical and Social Science Methodology
320. Historiography

The University Program in Marine Sciences

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are Botany, Chemistry, Geology, and Zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the *Duke University Marine Laboratory Bulletin*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

The following courses are offered during the summer at Beaufort. See the *Duke University Marine Laboratory Bulletin* for the current schedule of courses.

Professors

Cazlyn Green Bookhout, Ph.D. (Duke); John Costlow, Ph.D. (Duke), *Director;* Terry W. Johnson, Jr., Ph.D. (Michigan).

Associate Professors

Richard T. Barber, Ph.D. (Stanford); [*]Orrin Pilkey, Ph.D. (Florida State); [*]Richard B. Searles, Ph.D. (California at Berkeley).

Assistant Professors

Rodger W. Baier, Ph.D. (Washington); Richard B. Forward, Ph.D. (California at Santa Barbara), John Gutknecht, Ph.D. (North Carolina); J. Bolling Sullivan, Ph.D. (Texas); John Sutherland, Ph.D. (California at Berkeley).

[*] In residence at the Marine Laboratory during the summer only.

Courses of Instruction

S202. Introduction to Comparative Behavior
203. Marine Ecology
205. Geological Oceanography
S205. Introductory Marine Microbiology
211. Marine Phycology
212. Marine Membrane Physiology
214. Biological Oceanography
240. Chemical Oceanography
250. Physiological Ecology of Marine Animals
274. Marine Invertebrate Zoology
276. Comparative and Evolutionary Biochemistry
S277. Endocrinology of Marine Animals
S278. Invertebrate Embryology

Mathematics

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis project involving the use of the computer.

All A.M. and Ph.D. candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will normally take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded course work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. candidate should satisfy the language requirement in one of these languages as early as possible. The department urges students to attain a reading knowledge of at least two of these languages. Members of the faculty remain free to assign readings in them for course work or dissertation work.

Professors

Leonard Carlitz, Ph.D. (Pennsylvania), *James B. Duke Professor of Mathematics;* Francis George Dressel, Ph.D. (Duke); Francis Joseph Murray, Ph.D. (Columbia); Joseph Robert Shoenfield, Ph.D. (Michigan), *Chairman;* Seth L. Warner, Ph.D. (Harvard); Morris Weisfeld, Ph.D. (Yale); Max Adkin Woodbury, Ph.D. (Michigan).

Associate Professors

Donald Stanley Burdick, Ph.D. (Princeton), *Director of Graduate Studies;* Richard Earl Hodel, Ph.D. (Duke); Lawrence Carlton Moore, Jr., Ph.D. (California Institute of Technology); Richard Arthur Scoville, Ph.D. (Yale); David Alexander Smith, Ph.D. (Yale); Olaf Patrick Stackelberg, Ph.D. (Minnesota).

Assistant Professors

Charles Ward Henson III, Ph.D. (MIT); David Paul Kraines, Ph.D. (California at Berkeley); Jack A. Lees, Ph.D. (Chicago); Barry MacKichan, Ph.D. (Stanford); William Michael O'Fallon, Ph.D. (North Carolina); William Edwin Wilkinson, Ph.D. (North Carolina); Kai-Tac Wong, Ph.D. (Princeton).

Courses of Instruction

204. Geometry for Teachers
206. Introduction to Stochastic Processes
207, 208. Introduction to Algebraic Structures
217, 218. Intermediate Analysis
221, 222. Numerical Analysis
223. Numerical Analysis III
*227, 228. Theory of Numbers
*229, 230. Algebraic Numbers
*234. Sample Designs
235, 236. Algebra
244. Analysis of Variance
*245, 246. Combinatorial Analysis
*247, 248. Arithmetic of Polynomials
260. Design of Experiments
*262. Non-Parametric Statistics
265, 266. Homological Algebra and its Applications
271, 272. Introductory Topology
*273, 274. Algebraic Topology
*275, 276. Probability
284. Least-Squares Analysis of Linear Models
285. Applied Mathematical Methods I

286. Applied Mathematical Methods II
*287, 288. Foundations of Mathematics
290. Stochastic Processes
291, 292. Analysis I, II
293. Multivariate Statistics
*295. Mathematical Foundations of Statistical Inference
*297, 298. Axiomatic Set Theory
*303, 304. Advanced Theory of Numbers
325, 326. Analysis III, IV
*327, 328. Partial Differential Equations
*329, 330. Theory of Distributions
*331, 332. Advanced Topics in Complex Variables
*333, 334. Analytic Theory of Numbers
*335, 336. Topics in Algebra
*343, 344. Differential Equations
*353, 354. Topics in Analysis
361, 362. Hilbert Space
*371, 372. Dimension Theory
*377, 378. Topics in Topology
*383, 384. Lie Groups and Algebras
*392. Nuclear Spaces
*393. Topological Groups
*394. Topological Rings
*395, 396. Topological Algebra
*397, 398. Seminar in Algebra and Number Theory

*Offered on demand.

Medieval and Renaissance Studies

A graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. requirements for that discipline, and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance area (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art history, language and literature, history, philosophy, and religion. In other words, a student is enabled to minor in medieval and Renaissance studies.

Inquiries should be addressed to the Chairman of the Duke University Committee on Medieval and Renaissance Studies, P. O. Box 466, Duke Station.

ART

Courses of Instruction

233. Early Medieval Architecture
234. Romanesque Sculpture
237. French Renaissance Art
238. Sienese Painting
248. Florentine Painting during the Renaissance
251-252. Research
253. Studies in Italian Renaissance Sculpture
255, 256. Iconological Problems

LATIN

221. Medieval Latin I
222. Medieval Latin II
312. Proseminar in Latin Palaeography
Seminar in Textual Criticism

CLASSICAL STUDIES

Seminar in Byzantine History

ENGLISH

207, 208. History of the English Language
210. Old English Literary Tradition
212. Middle English Literary Tradition
215, 216. Chaucer
221. English Prose of the Sixteenth Century
222. English Non-Dramatic Poetry of the Sixteenth Century
223. Spenser
224. Shakespeare
225, 226. Tudor and Stuart Drama, 1500-1642
229. English Literature of the Seventeenth Century
232. Milton
310. Beowulf
312. Studies in Middle English Literature
315. Studies in Chaucer
318. Medieval Romances
320. Studies in Renaissance English Prose
324. Studies in Shakespeare
329. Studies in the Metaphysical Poets
383. Textual Criticism

GERMAN

205, 206. Middle High German
215. Seventeenth-Century Literature
216. History of the German Language
217. Renaissance and Reformation Literature

HISTORY

221-222. Problems in the History of Late Medieval and Early Modern Europe
237-238. Europe in the Middle Ages, 395-1500
267-268. From Medieval to Early Modern England
305-306. Seminar in British History
337-338. Seminar in Medieval History
351.10-352.10 Medieval Europe
351.15-352.15 The English Renaissance

PHILOSOPHY

218. Medieval Philosophy

RELIGION

236. Luther and the Reformation in Germany
241. Problems in Reformation Theology
251. The Counter-Reformation and the Development of Catholic Dogma
331 The Social Message of the Early and Medieval Church
332. The Medieval Church
334 Church Reformers and Christian Unity
336. Christian Mysticism in the Middle Ages
338. Calvin and the Reformation in Switzerland
339. The Radical Reformation
344. Zwingli and the Origins of Reformed Theology

FRENCH

213, 214. French Literature of the Seventeenth Century
219 Old French Literature
224 History of the French Language
225, 226. From Renaissance to Baroque in French Literature to the Sixteenth Century

ITALIAN

288. The Renaissance
284. Dante

SPANISH

251. The Origins of the Spanish Novel
252. Spanish Lyric Poetry Before 1700
253. The Origins of the Spanish Theater
257. Old Spanish
258. Old Spanish Literature
265. Golden Age Literature: Cervantes
266. Golden Age Literature: The Drama

Microbiology and Immunology

The Department of Microbiology and Immunology offers graduate work leading to the Ph.D. degree. Prerequisites for full admission include undergraduate training in the physical as well as the biological sciences and minimally include general physics, calculus, organic chemistry, biochemistry, and physical chemistry. Provisional admission is granted to applicants who lack physical chemistry but agree to make up this deficiency at Duke. There is no language requirement. GRE scores in verbal, quantitative, and advanced examinations weigh heavily in determining admission and fellowship awards. NIH traineeships are available for full-time study in microbiology and immunology. A candidate for the Doctor of Philosophy degree must pass both written and preliminary examinations. These are given during the student's second year after he has earned 45 semester hours of residence credit. A brochure describing the Doctor of Philosophy program and research in the department can be obtained by writing the Director of Graduate Studies.

Professors

D. Bernard Amos, M.D. (Guys Hospital, London), *James B. Duke Professor of Immunology;* Joseph Willis Beard, M.D. (Vanderbilt), *James B. Duke Professor of Virology,* Richard O.

Burns, Ph.D. (Illinois); Norman F. Conant, Ph.D. (Harvard), *James B. Duke Professor of Microbiology;* Eugene D. Day, Ph.D. (Delaware); Wolfgang Karl Joklik, D.Phil. (Oxford), *James B. Duke Professor of Microbiology and Immunology and Chairman of the Department;* Richard S. Metzgar, Ph.D. (Buffalo); Suydam Osterhout, M.D., Ph.D. (Rockefeller Institute); Hilda Pope Willett, Ph.D. (Duke).

Associate Professors

C. Edward Buckley, III, M.D. (Duke); Rebecca H. Buckley, M.D. (North Carolina); Wendell Rosse, M.D. (Chicago); H. F. Seigler, M.D. (North Carolina); Robert. W. Wheat, Ph.D. (Washington).

Assistant Professors

Dani P. Bolognesi, Ph.D. (Duke); Peter K. Lauf, Ph.D. (Freiburg); Ronald B. Luftig, Ph.D. (California Institute of Technology); Jack L. Nichols, Ph.D. (Alberta); David W. Scott, Ph.D. (Yale); Ralph E. Smith, Ph.D. (Denver); Thomas C. Vanaman, Ph.D. (Duke); Frances E. Ward, Ph.D. (Brown); Hans Zweerink, Ph.D. (Cornell).

Courses of Instruction

215. Bacteriophage: Structure and Function
219. Molecular and Cellular Basis of Development
219S. Optional Seminar Offered in Conjunction with Microbiology 219
221. Medical Microbiology
233. Microbiology
252. General Animal Virology and Viral Oncology
282. Molecular Microbiology
291, 292. Immunology I and II
311. Immunochemistry
313. Immunohematology
323. Readings in Bacteriology and Immunology
325. Medical Mycology
331, 332. Microbiology-Immunology Seminar
336. Immunogenetics
420. Cellular Immunophysiology

Pathology

The Department of Pathology offers graduate work leading to the Ph.D. degree with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of biophysical, biomathematical, and biochemical approaches. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of specialty and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

Professors

Bernard F. Fetter, M.D. (Duke); Donald B. Hackel, M.D. (Harvard); William W. Johnston, M.D. (Duke); Thomas D. Kinney, M.D. (Duke), *Chairman, R. J. Reynolds Tobacco Company Professor of Medical Education;* Joachim R. Sommer, M.D. (Munich), *Director of Graduate Studies;* Philip Pratt, M.D. (Johns Hopkins); F. Stephen Vogel, M.D. (Western Reserve); Benjamin Wittels, M.D. (Minnesota).

Associate Professors

William D. Bradford, M.D. (Western Reserve); Jane G. Elchlepp, Ph.D. (Iowa), M.D. (Chicago); Gordon K. Klintworth, M.D., Ph.D. (Witwatersrand); Norman B. Ratliff, M.D. (Duke).

Assistant Professors

Dolph O. Adams, M.D., Ph.D. (North Carolina); Darrell D. Bigner, M.D., Ph.D. (Duke); Edward H. Bossen, M.D. (Duke); Charles Daniels, M.D., Ph.D. (Duke); Frank C. Dorsey, Ph.D. (Duke); Hugo Jauregui, M.D., Ph.D. (Duke); Henry Sage, Ph.D. (Yale); George Spooner, Ph.D. (North Carolina); Craig Tisher, M.D. (Washington Univ.); James W. Wilson, Ph.D. (Kentucky), M.D. (Duke).

Courses of Instruction

219. Molecular and Cellular Basis of Development
219S. Seminar
250. General Pathology

251. Laboratory Course in General Pathology
325. Cardiovascular Pathology
352. Basic Problems in Chemical Pathology
353. Advanced Neuropathology
355, 356. Graduate Seminar in Pathology
357. Research in Pathology
358. Cellular and Subcellular Pathology
360. Histochemistry
361, 362. Autopsy Pathology
364. Systemic Pathology
367, 368. Special Topics in Pathology
369. Ophthalmic Pathology
370. Developmental Pathology and Teratology
373. Cytopathology
374. Pulmonary Pathology and Postmortem Pathophysiology
375. Fundamentals of Electron Microscopy
377. Pathology of the Kidney
378. Immunopathology
379. Pathology of Virus Infections

Philosophy

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophical analysis, ethics, aesthetics, political philosophy, and philosophy of law.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take two or three qualifying examinations, diagnostic in purpose. One examination is in the history of philosophy, ancient and modern; a second examines his ability to deal critically and systematically with some basic philosophical topic; a third examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor field, not necessarily confined to any one department, is encouraged but not required. A minor normally incudes 6 units for the A.M. or the Ph.D. and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree, or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

Professors

Glenn Robert Negley, Ph.D. (Chicago); William Bernard Peach, Ph.D. (Harvard); Paul Welsh, Ph.D. (Cornell), *Chairman.*

Associate Professors

Edward P. Mahoney, Ph.D. (Columbia); George W. Roberts, Ph.D. (Cambridge); David H. Sanford, Ph.D. (Cornell), *Acting Director of Graduate Studies.*

Assistant Professors

Richard E. Aquila, Ph.D. (Northwestern); Theodore Benditt, Ph.D. (Pittsburgh); David Coder, Ph.D. (Cornell).

Visting Associate Professor

J. D. G. Evans, Ph.D. (Cambridge).

Courses of Instruction

202. Aesthetics: The Philosophy of Art
203. Contemporary Ethical Theories
204. Philosophy of Law
205. Philosophy of History

208. Political Values
211. Plato
217. Aristotle
218. Medieval Philosophy
*219. Kant's Moral Philosophy
225. British Empiricism
227. Continental Rationalism
228. Recent and Contemporary Philosophy
*229. American Pragmatism
230. The Meaning of Religious Language
231. Classical German Philosophy
232. Recent Continental Philosophy
233. Methodology of the Empirical Sciences
234. Problems in the Philosophy of Science
241. Symbolic Logic
251. Epistemology
252. Metaphysics
253. Philosophy of Mind
260. Wittgenstein
287, 288. Foundations of Mathematics
291, 292. Seminar in Special Fields of Philosophy
331, 332. Seminar in Special Fields of Philosophy

*Offered on demand.

Physical Therapy

The Department of Physical Therapy offers a graduate program leading to the M.S. degree. Before undertaking graduate work in physical therapy a student should have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and mathematics. As part of the prescribed curriculum of the first year, students are required to take Anatomy 300 and Physiology 200. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3247, Duke University Medical Center.

Associate Professor

Eleanor F. Branch, Ph.D. (Duke).

Assistant Professors

Jane S. Mathews, M.P.H. (North Carolina), *Acting Chairman and Director of Graduate Studies;* Elia E. Villanueva, M.A. (Duke).

Courses of Instruction

201, 202. Seminar in Physical Therapy
217. Physical Therapy Dynamics I
218. Physical Therapy Dynamics II
220. Physical Therapy Dynamics III
230. Physical Evaluation and Instrumentation
234. Introductory Pathology
236. Medical Sciences
*238. Introduction to Health Service Systems
242. Directed Clinical Experience in Physical Therapy I
243. Directed Clinical Experience in Physical Therapy II
301. Introduction to Scientific Inquiry
*315. Curriculum Development
316. Directed Teaching in Physical Therapy
*320. Sensorimotor Mechanism Related to Rehabilitation
*322. Case Conferences in Rehabilitation
332. Administration of Physical Therapy Services
341-342. Advanced Seminar—Selected Problems
350. Research

Physics

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields of high current interest, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the

Ph.D. The option of taking the A.M. without thesis is available, with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

Professors

L. C. Biedenharn, Jr., Ph.D. (MIT); Edward G. Bilpuch, Ph.D. (North Carolina); Henry A. Fairbank, Ph.D. (Yale), *Chairman;* Walter Gordy, Ph.D. (North Carolina), LL.D., D.H.C., *James B. Duke Professor of Physics;* Eugene Greuling, Ph.D. (Indiana); Harold W. Lewis, Ph.D. (Duke), Horst Meyer, D.Sc. (Geneva); Henry W. Newson, Ph.D. (Chicago), *James B. Duke Professor of Physics;* Hugh G. Robinson, Ph.D. (Duke); William D. Walker, Ph.D. (Cornell).

Associate Professors

Ron Y. Cusson, Ph.D. (California Institute of Technology); Lawrence E. Evans, Ph.D. (Johns Hopkins), *Director of Graduate Studies;* Lloyd R. Fortney, Ph.D. (Wisconsin); Moo-Young Han, Ph.D. (Rochester); Russell Roberson, Ph.D. (Johns Hopkins); Richard L. Walter, Ph.D. (Notre Dame).

Assistant Professors

Frank C. DeLucia, Ph.D. (Duke), James S. Loos, Ph.D. (Illinois); Eberhard Karl Riedel, Ph.D. (Munich); Carl M. Rose, Ph.D. (Chicago); John Sykes, Ph.D. (Birmingham).

Adjunct Professors

Herman Robl, Ph.D. (Vienna); Katherine Way, Ph.D. (North Carolina).

Courses of Instruction

*209. Introduction to Solid State Physics
215. Introduction to Quantum Mechanics
217, 218. Advanced Physics Laboratory and Seminar
220. Advanced Electronics
*221, 222. Theoretical Physics
223, 224. Electricity and Magnetism
302. Advanced Mechanics
303. Statistical Mechanics
*304. Advanced Topics in Statistical Mechanics
305. Introduction to Nuclear Physics
*306. Low Temperature Physics
308. Introduction to High Energy Physics
309. Solid State Physics I
*310. Solid State Physics II
312. Phase Transitions and Critical Phenomena
316. Principles of Quantum Theory
317. Intermediate Quantum Theory
318, 319. Electromagnetic Field Theory
*330. Nuclear Structure Theory
*331. Microwave Radiation
*335. Microwave Spectroscopy
*341. Advanced Topics in Quantum Theory
*342. Theory of Elementary Particles
*343. Nuclear Physics
*344. Advanced Nuclear Physics
*345. High Energy Physics
*346. Topics in Theoretical Physics
351, 352. Seminar
397, 398. Low Temperature and Solid State Seminar

*Offered on demand

Physiology and Pharmacology

In the Department of Physiology and Pharmacology graduate work is offered leading to the Ph.D. degree. Before undertaking graduate work in physiology or pharmacology a student should have a strong background in basic sciences including course work in mathematics, chemistry, physics, and biology. Students are accepted for graduate work who have undergraduate majors in any of the following areas: biology, chemistry, physics, or engineering. A brochure is available from the department which describes the program of study, financial assistance, facilities, and the research activities of the staff.

Professors

F. Bernheim, Ph.D. (Cambridge), *James B. Duke Professor of Pharmacology;* J. J. Blum, Ph.D. (Chicago); George H. Hitchings, Ph.D. (Harvard); F. Jobsis, Ph.D. (Michigan), E. A.

Johnson, M.D. (Sheffield, England); L. Lack, Ph.D. (Columbia); Robert Arthur Maxwell, Ph.D. (Princeton); J. W. Moore, Ph.D. (Virginia); T. Narahashi, Ph.D. (Tokyo); Charles Adams Nichol, Ph.D. (Wisconsin); E. M. Renkin, Ph.D. (Harvard); G. Somjen, M.D. (New Zealand); D. C. Tosteson, M.D. (Harvard), *Chairman, James B. Duke Professor of Physiology.*

Associate Professors

R. E. Fellows, Jr., M.D. (McGill), Ph.D. (Duke); Johannes A. Kylstra, M.D., Ph.D. (Leiden); P. K. Lauf, M.D. (Freiburg); Daniel B. Menzel, Ph.D. (California at Berkeley); T. J. McManus, M.D. (Boston), *Director of Graduate Studies;* A. Ottolenghi, M.D. (Pavia); G. M. Padilla, Ph.D. (California at Los Angeles); Herbert S. Posner, Ph.D. (George Washington); J. V. Salzano, Ph.D. (Iowa); S. Schanberg, Ph.D., M.D. (Yale); M. Wolbarsht, Ph.D. (Johns Hopkins).

Assistant Professors

N. C. Anderson, Ph.D. (Purdue); Howard L. Elford, Ph.D. (Cornell); Joseph C. Greenfield, M.D. (Emory); Robert Burns Gunn, M.D. (Harvard); J. Gutknecht, Ph.D. (North Carolina); Gary Kirk, Ph.D. (Yale); M. Lieberman, Ph.D. (State Univ. of New York at Brooklyn); L. M. Mendell, Ph.D. (MIT); E. Mills, Ph.D. (Columbia); C. W. Schomberg, Ph.D. (Purdue); James M. Schooler, Ph.D. (Wisconsin); Theodore Alan Slotkin, Ph.D. (Rochester); H. C. Wachtel, Ph.D. (New York Univ.).

Visiting Professor

J. Schoffeniels, M.D. (Liège).

Courses of Instruction

200. Physiology of Man
201. Pharmacology: Mode of Action of Drugs
207. Cardiovascular and Respiratory Physiology and Pharmacology I
208. Respiratory System in Health and Disease
210, 211. Individual Study and Research
212. Marine Membrane Physiology
213. Cellular and Chemical Pharmacology
215. Topics in Developmental Physiology and Pharmacology
216. Contractile Processes in Physiology and Pharmacology
217. Membrane Transport Processes in Physiology and Pharmacology
218. Physiological Instrumentation
230. Molecular and Cellular Basis of Development
230S. Optional seminar offered in conjunction with Physiology 230
279. Student Tutorial in Physiology and Pharmacology
280. Student Seminar in Physiology and Pharmacology
330. Pharmacological Basis of Clincial Medicine
331. Laboratory Methods in Pharmacology
342. Current Topics in Cardiac Muscle Physiology
372. Research in Physiology and Pharmacology
393. Integrative and Clinical Neurophysiology and Neuropharmacology
395. Biochemical Pharmacology
401. Metabolic and Developmental Physiology and Pharmacology
403. Endocrinology and Reproduction
412. Advanced Seminar in Endocrinology and Reproductive Physiology I
413. Advanced Seminar in Endocrinology and Reproductive Physiology II
414. Analysis of Physiological Systems
416. Neuronal Physiology and Pharmacology
420. Cellular Immunophysiology

Political Science

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government.

Fields in which instruction is at present offered are American government and politics (including constitutional law, public administration, the legislative and judicial processes, and state and local government); comparative government and politics (including Western Europe, Southern Asia, Latin America, Africa, the Soviet Union, and the Commonwealth); political theory; international relations (including international law and international organization); and empirical theory and methodology.

Candidates for the master's degree are required to show proficiency in one modern foreign language and to submit either a thesis or thesis equivalent. The latter option is open only to students going on for the Ph.D. The thesis equivalent is defined as a major research paper substituted for the thesis on recommendation of the student's supervisor and with the approval of the Director of Graduate Studies.

The candidate for the degree of Doctor of Philosophy in political science must elect four fields, at least three of which must be selected from the fields enumerated above and one of which must be in a related department. He must also demonstrate a reading knowledge of two foreign languages which have been approved by the professor who supervises his dissertation, or he must demonstrate proficiency in one such foreign language and in the use of statistics.

Professors

M. Margaret Ball, Ph.D. (Stanford); James David Barber, Ph.D. (Yale), *Chairman;* Ralph Braibanti, Ph.D. (Syracuse), *James B. Duke Professor of Political Science;* Frederic N. Cleaveland, Ph.D. (Princeton); Robert Taylor Cole, Ph.D. (Harvard), *James B. Duke Professor of Political Science;* Samuel DuBois Cook, Ph.D. (Ohio State); Kazimierz Grzybowski, S.J.D. (Harvard); Hugh Marshall Hall, Jr., Ph.D. (Texas); John Hamilton Hallowell, Ph.D. (Princeton); Allan Kornberg, Ph.D. (Michigan); Wladyslaw W. Kulski, Dr.Jur. (Paris School of Law), *James B. Duke Professor of Russian Affairs;* Richard H. Leach, Ph.D. (Princeton).

Associate Professors

Peter Fish, Ph.D. (Johns Hopkins), *Director of Graduate Studies;* Sheridan Johns, III, Ph.D. (Harvard).

Assistant Professors

Albert Eldridge, Ph.D. (Kentucky); Willis F. Hawley, Ph.D. (California at Berkeley); David Paletz, Ph.D. (California at Los Angeles); Thomas S. Spragens, Ph.D. (Duke); Richard Trilling, Ph.D. (Wisconsin); Arturo Valenzuela, M.A. (Columbia).

Courses of Instruction

207. American Constitutional Interpreta-
209. Problems in State Government and Politics
210. The Politics of Education
214. Comparative Administrative Law
220. Problems in International Politics
221. International Organization
222. Empirical Theory
223. Political Philosophy from Plato to Machiavelli
224. Modern Political Theory
225. Comparative Government and Politics —Western Europe
226. Theories of International Relations
227. International Law
229. Recent and Contemporary Political Theory
230. American National Government
231. American Political Theory
233. Research Methodology
235. The Commonwealth
236. Statistical Analysis
237. Problems in American Foreign Policy
241. Public Administrative Organization and Management
243. Administrative and Organizational Theory
244. Administrative Law and Process
246. Administration and Public Policy
249. Comparative Political Analysis and Political Development
250. Comparative Government and Politics —Southern Asia
253. Comparative Government and Politics: Latin America
260. The Tradition of Political Inquiry
271. Political Processes in Traditional and Modern Africa
274. Political Psychology
275. The American Party System
277. Comparative Party Politics
279. The Legislative Process
280. Comparative Government and Politics—Sub-Saharan Africa
285. The Judicial Process
291. Problems of Urban Government
293. Federalism
310. Seminar in State and Local Government
312. Seminar in Constitutional Law
313. Education and Public Policy
321. Seminar in Political Theory
325. Seminar in Comparative Government and Politics
328. Seminar in International Law

329. Seminar in International Regional Organization
330. Seminar in Comparative Government and Politics—Southern Asia
331. Seminar in American Political Thought
341. Seminar in Public Administration
342. Seminar in American National Government and Politics
343. Seminar in the Policy Process
344. Workshop on Computer Models of Social Systems
360. Seminar in Government and Politics in the Soviet Union
361. Seminar in Foreign Relations of the Soviet Union
376. Seminar in Comparative Political Behavior
377. Seminar in Canadian Political Behavior
380. Seminar in African Government and Politics
381. Seminar in Latin American Government and Politics
382. Soviet Law and Society
401. Seminar in the Commonwealth
402. Interdisciplinary Seminar in the History of the Social Sciences

Psychology

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

Professors

Irving Emanuel Alexander, Ph.D. (Princeton); Lloyd Joseph Borstelmann, Ph.D. (California at Berkeley); Jack Williams Brehm, Ph.D. (Minnesota); Robert Charles Carson, Ph.D. (Northwestern); Irving Thomas Diamond, Ph.D. (Chicago), *James B. Duke Professor of Psychology;* Norman Guttman, Ph.D. (Indiana); Edward Ellsworth Jones, Ph.D. (Harvard), *Chairman;* Martin Lakin, Ph.D. (Chicago); Gregory Roger Lockhead, Ph.D. (Johns Hopkins); Harold Schiffman, Ph.D. (Princeton); John Staddon, Ph.D. (Harvard), *Director of Graduate Studies.*

Associate Professors

Carl John Erickson, Ph.D. (Rutgers); Robert Porter Erickson, Ph.D. (Brown); Cliff Waldron Wing, Jr., Ph.D. (Tulane).

Assistant Professors

David Aderman, Ph.D. (Wisconsin); John D. Coie, Ph.D. (California at Berkeley); Philip Robert Costanzo, Ph.D. (Florida); William C. Hall, Ph.D. (Duke); William Kalat, Ph.D. (Pennsylvania); Irwin Kremen, Ph.D. (Harvard); Thomas T. Norton, Ph.D. (California at Los Angeles); G. M. Robinson, Ph.D. (Chicago); Charles W. White, Ph.D. (Stanford).

Lecturers

John H. Cassedy, Ph.D. (Indiana); Edward Clifford, Ph.D. (Minnesota); Elaine Kobrin Crovitz, Ph.D. (Duke); Herbert Floyd Crovitz, Ph.D. (Duke); Ila Gehman, Ed.D. (Pennsylvania State); W. Doyle Gentry, Ph.D. (Florida State); Marcel Kinsbourne, M.D. (Oxford); Arnold David Krugman, Ph.D. (Kentucky); Walter Dorn Obrist, Ph.D. (Northwestern); Talmadge Lee Peele, M.D. (Duke); William Derek Shows, Ph.D. (Duke); George G. Somjen, M.D. (New Zealand); Larry W. Thompson, Ph.D. (Florida State); M. L. Wolbarsht, Ph.D. (Johns Hopkins).

Courses of Instruction

203. Sensation and Perception
204. Comparative Psychology
210. Cognition and Higher Mental Processes
211. The Problem Child
213. Adaptive Behavior
215. Developmental Psychology
216. Biological Psychology
217. Social Psychology
218. Research Methods in Social Psychology
219. Physiological Psychology I

220. Physiological Psychology II
234. Seminar in Personality
236. Theoretical Psychology
238. The Electroencephalogram and Psychological Function
239. Behavioral Correlates of Brain Damage in Man
245. Personality Theory I
246. Personality Theory II
271. 1-4. Seminar in Selected Problems
271. 5. Comparative Neurology and Psychology
273-274. Principles of Psychological Measurement
282. Introduction to Methods in Psychotherapy
283, 284. The History of Psychology
291. Seminar in Community Mental Health
293. Methods in Developmental Psychology
305. Psychopathology
306. Seminar in Developmental Psychology
309. Seminar in Learning
310. Seminar in Perception
313. Seminar on the Concept of the Reflex
314. Seminar in Instrumental Behavior
316. Seminar in Social Psychology
317. Seminar in Social Behavior
318. Seminar in Social Influence
319-320. Student-Faculty Research Conference
321. Seminar in Psychophysiology of Hearing
324. Seminar: Behavioral Studies of the Brain
325. Seminar in Neuroendocrinology and Behavior
327, 328. Foundations of Clinical Psychology
329-330. Seminar in Psychology
335-336. Clinical Inquiry I
337. Seminar in Sensory Discrimination
340. Group Processes and Sensitivity Training
343, 344. Clinical Inquiry II
347-348. Personality Assessment
350. Practicum in Psychological Research

Religion

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) Biblical studies; (2) historical studies, and (3) systematic and contemporary studies.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as Classical Studies, History, Political Science, or Sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a grounding in religion such as is normally derived from the course content of theoretical subjects of a seminary curriculum. Candidates for admission to the doctoral program are favored, therefore, who hold a B.D. or equivalent degree from an accredited seminary or who have had at least two years of seminary study beyond the A.B. degree. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only on the condition of satisfactory completion of the A.M. degree with the department.

Candidates for the Ph.D. degree must complete the language requirements not later than the beginning of the second year of residence.

Professors

Frank Baker, B.D., Ph.D. (Nottingham); W. Waldo Beach, B.D., Ph.D. (Yale); David Bradley, Ph.D. (Yale); Robert E. Cushman, B.D., Ph.D., L.H.D. (Yale); William David Davies, B.D., M.A., D.D. (Wales), *George Washington Ivey Professor of Advanced Studies and Research in Christian Origins;* Stuart C. Henry, B.D., Ph.D. (Duke); Frederick L. Herzog, Th.D. (Princeton); Creighton Lacy, B.D., Ph.D. (Yale); Thomas A. Langford, B.D., Ph.D. (Duke); Roland E. Murphy, S.T.D. (Catholic University); Robert Osborn, B.D., Ph.D. (Drew); William H. Poteat, B.D., Ph.D. (Yale), *Chairman;* James L. Price, B.D., Ph.D. (Cambridge); D. Moody Smith, Jr., B.D., Ph.D. (Yale); Franklin W. Young, D.B., Ph.D. (Duke), *Director of Graduate Studies, Amos Ragan Kearns Professor of New Testament and Patristic Studies.*

Associate Professors

Lloyd Richard Bailey, Ph.D. (Yale); Henry B. Clark, B.D., Ph.D. (Yale); Wesley A. Kort, B.D., Ph.D. (Chicago); Eric M. Meyers, Ph.D. (Harvard); Harry B. Partin, B.D., Ph.D. (Chicago);

Charles K. Robinson, B.D., Ph.D. (Duke); Harmon L. Smith, B.D., Ph.D. (Duke); David Curtis Steinmetz, Th.D. (Harvard); Orval Wintermute, B.D., Ph.D. (Johns Hopkins).

Assistant Professor

James H. Charlesworth, B.D., Ph.D. (Duke).

BIBLICAL STUDIES

Courses of Instruction

207. Second Hebrew
208. Second Hebrew
209. Old Testament Theology
223A. Exegesis of the Hebrew Old Testament: Amos and Hosea
223B. Exegesis of the Hebrew Old Testament: Job
223C. Exegesis of the Hebrew Old Testament: Exodus
225. Living Issues in New Testament Theology
226A. Exegesis of the Greek New Testaament I (Mark and Matthew)
226B. Exegesis of the Greek New Testament I (Romans)
226D. Exegesis of the Greek New Testament I (I and II Corinthians)
226E. The Gospel and Epistles of John
227A. Exegesis of the Greek New Testament II (Luke-Acts)
227B. Exegesis of the Greek New Testament II (Galatians)
227C. Exegesis of the Greek New Testa- II (The Pastoral Epistles)
228. The Theology of the Gospel and Epistles of John
237. History of the Ancient Near East
258. Coptic
302. Studies in the Intertestamental Literature
304. Aramaic
304A. Targumic Aramaic
305. Third Hebrew
306. Language and Literature of the Dead Sea Scrolls
307. Syriac
311. Pharisaic Judaism in the First Century
312. Pauline Theology
314. Judaism and Christianity in the New Testament
319. The Gospel According to St. Matthew in Recent Research
323A. Comparative Semitic I
323B. Comparative Semitic II
340-341. Seminar in the New Testament
342. The Archaeology of Palestine in Hellenistic-Roman Times
345. The Epistle to the Hebrews in Recent Research
350-351. Old Testament Seminar
373-374. Elementary Akkadian
375-376. Elementary Ugaritic
401. Colloquium in Biblical Studies

HISTORICAL STUDIES

217. Islam in India
218. Religion in Japan
236. Luther and the Reformation in Germany
241. Problems in Reformation Theology
251. The Counter-Reformation and the Development of Catholic Dogma
260. Seminar: Wesley Studies
280. The History of Religions
282. Myth and Ritual
283. Religions of East Asia
284. The Religion and History of Islam
285. The Vedic Tradition: Its Compilation and Interpretation
289. World Religions and Social Change
296. Religion on the American Frontier
308. Greek Patristic Texts
313. The Apostolic Fathers
315-316. Seminar: History of Religions
317. Seminar in the Greek Apologists
318. Seminar in the Greek Fathers
331. The Social Message of the Early and Medieval Church
332. The Medieval Church
334. Church Reformers and Christian Unity
335. The English Church in the Eighteenth Century
336. Christian Mysticism in the Middle Ages
338. Calvin and the Reformation in Switzerland
339. The Radical Reformation
344. Zwingli and the Origins of Reformed Theology
377. Contemporary American Dramatic Arts and Evolving Theological Forms
384. Religious Dissent in American Culture
385. Religion in American Literature
391. Historical Types of Christian Ethics I
392. Historical Types of Christian Ethics II
395. Christian Thought in Colonial America
396. Liberal Traditions in American Theology

SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology
211. Authority in Theology
230. The Meaning of Religious Language
231. Seminar in Christianity and Contemporary Thought
232. Religion and Literature: Perspectives and Methods
233. Modern Narrative and Religious Language
248. The Theology of Karl Barth
249. The Church in Contemporary Theology
281. Phenomenology and Religion
282. Myth and Ritual
292. Christian Ethics and International Relations
293. Sociological Analysis of Religion
294. Institutional Analysis of Religious Bodies
295. Ethics and Economic Life
300. Systematic Theology
303. The New Hermeneutic and the Idea of History
320. Hegel and Schleiermacher
322. Nineteenth Century European Theology
325. Philosophical Theology I
326. Philosophical Theology II
328. Twentieth-Century European Theology
333. Marxist Ideology and Christian Faith
361. Language and Biblical Criticism
380. Existentialist Thought
383. Moral Theology in the Twentieth Century
386. Christianity in Dialogue with Other Faiths
388. Ethics and Medicine
389. Christian Ethics and Contemporary Culture
390. Current Problems in Christian Ethical Theory
394. Christianity and the State
397. Contemporary American Theology
398. Colloquium on the College and University Teaching of Religion

Romance Languages

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for either the A.M. and Ph.D. degree will minor in a second Romance language; however, minor work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

Professors

Thomas Howard Cordle, Ph.D. (Yale); Gifford Davis, Ph.D. (Harvard); John Morton Fein, Ph.D. (Harvard), *Chairman;* Wallace Fowlie, Ph.D. (Harvard); Robert Niess, Ph.D. (Minnesota); Richard Lionel Predmore, D.M.L. (Middlebury); Marcel Tetel, Ph.D. (Wisconsin); Bruce W. Wardropper, Ph.D. (Pennsylvania), *William H. Wannamaker Professor of Romance Languages.*

Associate Professors

Alexander Hull, Ph.D. (Washington); Philip Stewart, Ph.D. (Yale); Patrick R. Vincent, Ph.D. (Johns Hopkins), *Director of Graduate Studies.*

Assistant Professors

Louis E. Auld, Ph.D. (Bryn Mawr); Ernesto Caserta, Ph.D. (Harvard).

FRENCH

Courses of Instruction

209. Advanced Composition and Syntax
210. The Structure of French
213, 214. French Literature of the Seventeenth Century
217. French Symbolism
219. Old French Literature
221, 222. The Nineteenth-Century French Novel
223. French Literary Criticism
224. History of the French Language

225, 226. From Renaissance to Baroque in French Literature of the Sixteenth Century
228. French Poetry of the Twentieth Century
233. Contemporary French Theater
234. Proust
241, 242. French Literature of the Eighteenth Century
245, 246. French Literature of the Twentieth Century
311, 312. French Seminar

ITALIAN

283. Italian Novel of the Novecento
284. Dante
288. The Renaissance

SPANISH

251. The Origins of the Spanish Novel
252. Spanish Lyric Poetry Before 1700
253. The Origins of the Spanish Theater
255, 256. Modern Spanish American Literature
257. Old Spanish
258. Old Spanish Literature
259. Spanish Phonetics
261. Nineteenth-Century Novel
262. Galdós
265. Golden Age Literature: Cervantes
266. Golden Age Literature: The Drama
275, 276. Contemporary Spanish Literature
321, 322. Hispanic Seminar

ROMANCE LANGUAGES

218. The Teaching of Romance Languages

Slavic Languages and Literature

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

Associate Professors

Bronislas de Leval Jezierski, Ph.D. (Harvard), *Director of Graduate Studies;* Magnus J. Krynski, Ph.D. (Columbia), *Chairman;* Michael I. Pavlov, Ph.D. (Leningrad).

Courses of Instruction

201, 202. The Novelists of Nineteenth-Century Russia
*205. The Structure of Polish in Relation to Russian
206. Readings in Contemporary Polish Prose in the Original
207. Soviet Literature and Culture
212. Pushkin
213. The Slavs: Literature and Culture, 1918-1939
214. The Slavs: Literature and Culture, 1940-1970
215, 216. Advanced Composition and Syntax
*224. The Russian Short Story—Eighteenth Century to the Present
225. Tolstoy
*227. Gogol
230. Chekhov and the Russian Prose of the Turn of the Century
232. Fyodor Dostoevsky
*236. Russian and Polish Romanticism

*Not offered in 1973-74.

Sociology

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Candidates for the Ph.D. degree in sociology are expected to demonstrate in qualifying and preliminary examinations a broad background in the various aspects of sociology—substantive, theoretical, and empirical. The program of each candidate is determined by a committee which reviews his previous work and sets the specific requirements to be met. These requirements will include work in related fields such as anthropology, economics, mathematics, philosophy, political science, or psychology. Emphasis is placed on the completion of the dissertation, directed by a member of the staff, demonstrating competence and independence in the investigation of an original and significant problem.

Further details of this program, the departmental facilities, the staff, and various stipends available, are described in a brochure which may be obtained from the Director of Graduate Studies.

Professors

Kurt W. Back, Ph.D. (MIT); Alan C. Kerckhoff, Ph.D. (Wisconsin), *Chairman;* George L. Maddox, Jr., Ph.D. (Michigan State); John C. McKinney, Ph.D. (Michigan State); George C. Myers, Ph.D. (Washington); Erdman B. Palmore, Ph.D. (Columbia); Jack H. Preiss, Ph.D. (Michigan State); Donald F. Roy, Ph.D. (Chicago); Joel Smith, Ph.D. (Northwestern); Edward A. Tiryakian, Ph.D. (Harvard).

Associate Professors

Ida Simpson, Ph.D. (North Carolina); John Wilson, D.Phil. (Oxford), *Director of Graduate Studies.*

Assistant Professors

Lee Brehm, Ph.D. (North Carolina); Robert B. Hartford, Ph.D. (Cornell); Charles Hirschman, Ph.D. (Wisconsin); James S. House, Ph.D. (Michigan); William Maxwell Mason, Ph.D. (Chicago).

Courses of Instruction

225. Medical Sociology
241. Social Stratification
242. The Sociology of Occupations and Professions
243. Population Dynamics and Social Change
247. Community and Society
251. The Sociology of Modernization
253. Social Institutions
255. Race and Culture
259. Religion and Social Change
272. The Socialization Process
275. Social Attitudes and Individual Behavior
278. Social Structure and the Life Cycle
295. Methodology in Sociology
297. Statistical Analysis in Sociology
298, 299. Seminar in Selected Topics
301. Seminar in Human Fertility
302. Seminar in Migration
325. Social Aspects of Mental Illness and Treatment
341. Special Problems of Complex Systems
344. Workshop on Computer Models of Social Systems
345, 346. Demographic Techniques I and II
351, 352. Seminar in Social Organization
361. Seminar in Comparative Sociology
373, 374. Social Psychological Issues in Sociology
381. Development of Sociological Theory
385, 386. Seminar in Sociological Theory
390. Seminar in Field Methods of Sociological Research
392. Individual Research in Sociology
397, 398. Seminar in Special Research Problems
402. Interdisciplinary Seminar in the History of the Social Sciences

Zoology

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the official detailed *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

Professors

Joseph R. Bailey, Ph.D. (Michigan); Cazlyn G. Bookhout, Ph.D. (Duke); John Buettner-Janusch, Ph.D. (Michigan); John D. Costlow, Jr. (Duke); Donald J. Fluke, Ph.D. (Yale), *Chairman;* John R. Gregg, Ph.D. (Princeton); Peter H. Klopfer, Ph.D. (Yale); Daniel A. Livingstone, Ph.D. (Yale); R. Bruce Nicklas, Ph.D. (Columbia); Knut Schmidt-Nielsen, Dr.Phil. (Copenhagen), *James B. Duke Professor of Physiology in Zoology;* Karl M. Wilbur, Ph.D. (Pennsylvania), *James B. Duke Professor of Zoology.*

Associate Professors

Richard T. Barber, Ph.D. (Stanford); Nicholas W. Gillham, Ph.D. (Harvard); Vance A. Tucker, Ph.D. (California at Los Angeles); Steven Vogel, Ph.D. (Harvard); Stephen A. Wainwright, Ph.D. (California), *Director of Graduate Studies;* Calvin L. Ward, Ph.D. (Texas).

Adjunct Associate Professor

Klaus Schmidt-Koenig, Ph.D. (Freiburg).

Assistant Professors

Richard B. Forward, Ph.D. (California at Santa Barbara); John G. Lundberg, Ph.D. (Michigan); David R. McClay, Ph.D. (North Carolina); John P. Sutherland, Ph.D. (California at Berkeley); H. Wilbur, Ph.D. (Michigan).

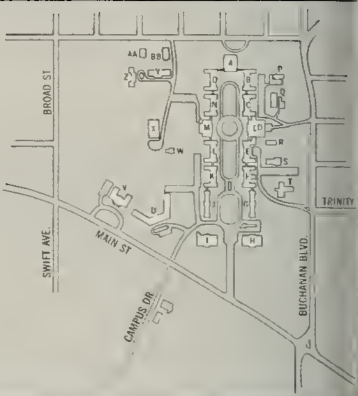
Courses of Instruction

201. Animal Behavior
202. Introduction to Comparative Behavior
203. Marine Ecology
204. Population and Community Ecology
205. Elements of Theoretical Biology
212. Marine Membrane Physiology
213. Ecological Oceanography
214. Biological Oceanography
216. Limnology
224 Vertebrate Zoology
229. Morphogenetic Systems
236. Human Genetics
238. Systematic Zoology
239. Biogeography: Seminar
240. Chemical Oceanography
245. Radiation Biology
246. Physical Biology
248. Introductory Biochemistry
250. Physiological Ecology of Marine Animals
252. Comparative Physiology
254. Fluid Flow and Living Systems: Seminar
258. Laboratory and Research Methods
260. Advanced Cell Biology
262. Cytological Materials and Methods
266. Topics in Cell Structure and Function
274. Marine Invertebrate Zoology
275. Invertebrate Zoology
276. Comparative and Evolutionary Biochemistry
277. Endocrinology of Marine Animals
278. Invertebrate Embryology
280. Principles of Genetics
286. Evolution
286L. Evolution
288. The Cell in Development and Heredity
295, 296. Seminar
333. Primate Evolution
334. Topics in Physical Anthropology
351, 352. Departmental Seminar
353, 354. Research
355, 356. Seminar
360, 361. Tutorials

MAP OF DUKE UNIVERSITY

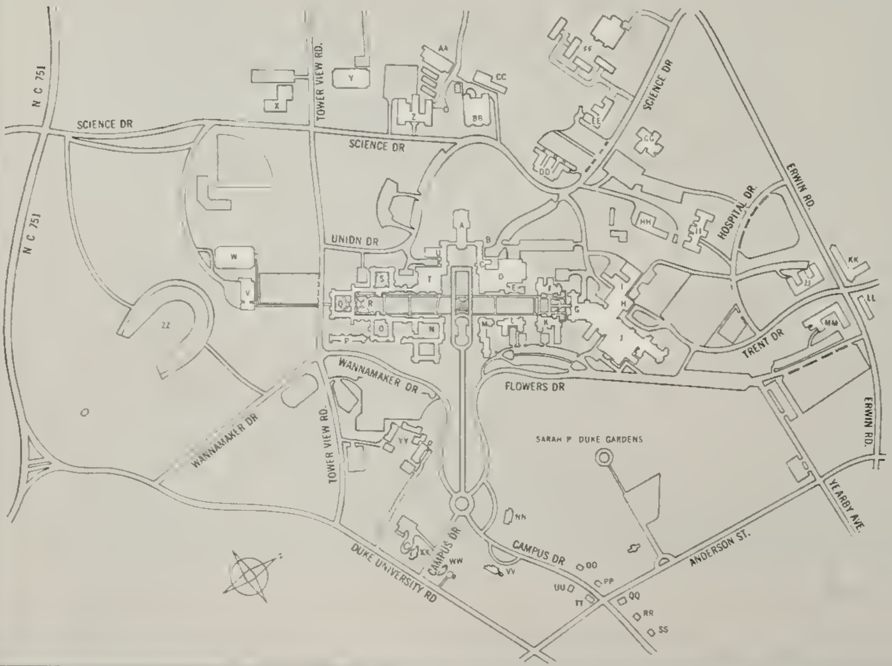
East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
O	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
O	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laborat
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Researc Buildings
GG	Nanaline H. Duke Medic Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
DD	Commonwealth Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Prog
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



BULLETIN OF DUKE UNIVERSITY
The Graduate School

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Undergraduate Instruction

Trinity College of Arts and Sciences

The School of Engineering

The School of Nursing

1973-1974

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University Calendar—1973-1974

1973

August	
30	Thursday—Orientation begins: assemblies for all new undergraduat students
31	Friday—Registration and matriculation of all new and nonregistere students
September	
4	Tuesday, 9:00 a.m.—Fall semester classes begin
October	
19	Friday—Last day for reporting midsemester grades
29–11/1	Monday–Thursday—Registration for spring, 1974
November	
20	Tuesday, 6:00 p.m.—Thanksgiving recess begins
26	Monday, 9:00 a.m.—Classes are resumed
December	
9	Sunday—Founders' Day
11	Tuesday, 6:00 p.m.—Fall semester classes end (undergraduate)
12–13	Wednesday–Thursday—Reading Period
14	Friday—Final examinations begin
21	Friday—Final examinations end

1974

January	
10	Thursday—Orientation begins: assemblies for all new students
14	Monday, 9:00 a.m.—Spring semester classes begin
February	
25	Monday—Last day for reporting midsemester grades
March	
15	Friday, 6:00 p.m.—Spring recess begins
25	Monday, 9:00 a.m.—Classes are resumed
April	
2–5	Tuesday–Friday—Registration for fall and summer, 1974
26	Friday, 6:00 p.m.—Spring semester classes end (undergraduate)
27–29	Saturday–Monday—Reading Period (undergraduate)
30	Tuesday—Final examinations begin
May	
7	Tuesday—Final examinations end
11	Saturday—Commencement begins
12	Sunday—Commencement: Baccalaureate Service and Graduation Exercises

niversity Administration

ENERAL ADMINISTRATION

erry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
ohn O. Blackburn, Ph.D., *Chancellor*
rederic N. Cleaveland, Ph.D., *Provost*
harles B. Huestis, *Vice President for Business and Finance*
illiam G. Anlyan, M.D., *Vice President for Health Affairs*
tephen Cannada Harward, A.B., C.P.A., *Treasurer*
. Peyton Fuller, A.B., *Controller*
arold Lewis, Ph.D., *Vice Provost and Dean of the Faculty*
ohn C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*
obert Krueger, D.Phil., *Vice Provost and Dean of Trinity College of Arts and Sciences*
oel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute of Policy Sciences and Public Affairs*
rederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
enjamin Edward Powell, Ph.D., *Librarian*
lark R. Cahow, Ph.D., *University Registrar*
ufus H. Powell, LL.B., *Secretary of the University*
ictor A. Bubas, B.S., *Assistant to the President*
. Kenneth Pye, LL.M., *University Counsel*

NDERGRADUATE ADMINISTRATION

obert Krueger, D.Phil., *Vice Provost and Dean of Trinity College of Arts and Sciences*
uby L. Wilson, R.N., Ed.D., *Dean of the School of Nursing*
eorge W. Pearsall, Sc.D., *Dean of the School of Engineering*
nne Flowers, Ed.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*
illiam J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
arold G. Wallace, B.D., *Dean of Black Affairs*
ichard L. Cox, B.D., Th.M., *Dean of Students*
ane Philpott, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences and Dean of Undergraduate Instruction*
orothy J. Brundage, R.N., M.N., *Acting Director of Undergraduate Studies of the School of Nursing*
ames Douthat, B.D., *Assistant Dean of Students*
tephen C. Frederick, A.B., B.D., *Assistant Dean of Trinity College of Arts and Sciences*
hett T. George, Jr., Ph.D., *Assistant Dean of the School of Engineering*
hirley Hanks, A.B., *Assistant to the Director of Career and Continuing Education*
artha Nan Hayes, A.A., *Assistant to the Dean of the School of Nursing*
lan W. Jenks, Th.D., *Assistant Dean of Trinity College of Arts and Sciences*
illian A. Lee, M.S.Ed., *Assistant Dean of Students*
ames C. Little, Diploma, A. and Div., B.D., *Assistant Dean of Trinity College of Arts and Sciences*
tto Meier. Jr., Ph.D., *Assistant Dean of the School of Engineering*
lizabeth Studley Nathans, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
ean F. O'Barr, Ph.D., *Director of Career and Continuing Education*
aula R. Phillips, A.B., *Assistant Dean of Trinity College of Arts and Sciences*
wen Sherrill, *Assistant to the Dean of Black Affairs*
lla E. Shore, M.R.E., M.A., *Dean of Student Affairs of the School of Nursing*
eroy P. Smith, M.S., *Assistant Dean of Trinity College of Arts and Sciences*
oward Strobel, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
erald L. Wilson, B.D., M.A., *Assistant Dean of Trinity College of Arts and Sciences*
llen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*

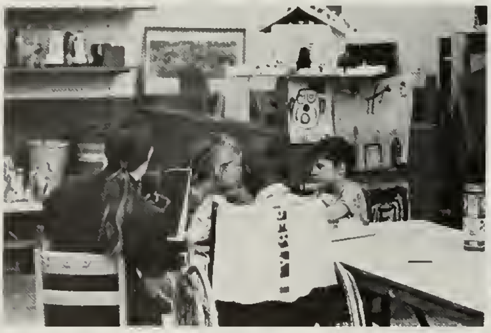
Boards of Visitors, Undergraduate Schools

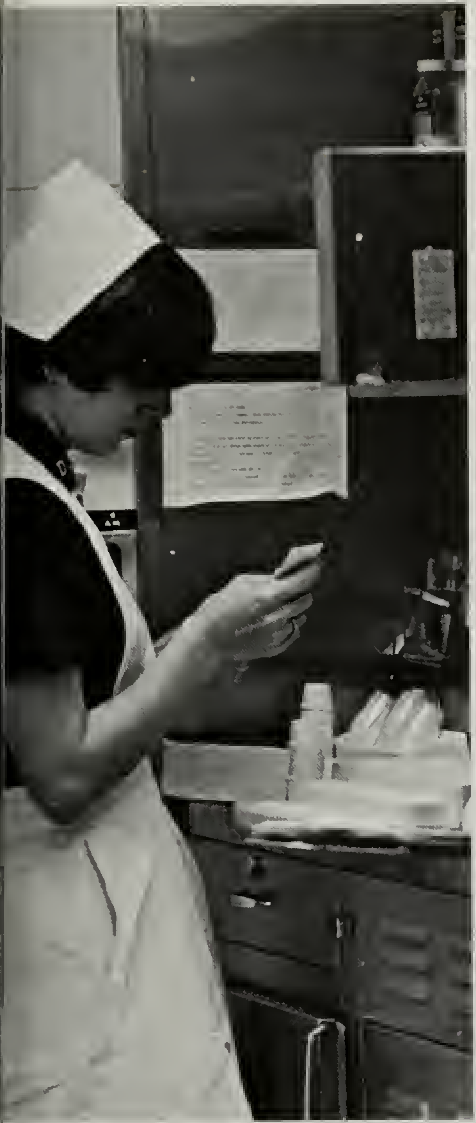
The School of Engineering

E. A. Bescherer, *Executive Director of Laboratories, Bell Telephone Company*
Carl C. Chambers, *Vice President for Engineering Affairs, University of Pennsylvania*
Carl F. Floe, *Vice President for Research Administration, Massachusetts Institute of Technology*
H. L. Flowers, *Deputy Director, Harpoon Program, McDonnel Douglas Astronautics Compan*
George R. Herbert, *President, Research Triangle Institute*
J. Herbert Hollomon, *Special Assistant to the President, Massachusetts Institute of Technolog*
William S. Lee, *Vice President for Engineering and Construction, Duke Power Company*
M. P. O'Brien, *Dean Emeritus, College of Engineering, University of California at Berkeley*
Robert H. Pinnix, *President, R. H. Pinnix, Inc.*
Joseph B. Platt, *President, Harvey Mudd College*
Mary D.B.T. Semans, *Alumna and Trustee of Duke University and the Duke Endowment*
W. Brewster Snow, *Quirk, Lawler, and Matusky Engineers*
F. W. Steckmest, *Consultant, Public Affairs, Shell Oil Company*

The School of Nursing (Medical Center Board)

Edward H. Benenson, *President, Benenson Management Company, Inc.*
John A. D. Cooper, *President, Association of American Medical Colleges*





Kenneth R. Crispell, *Dean, School of Medicine, University of Virginia*
Martin M. Cummings, *Director, National Library of Medicine*
James R. Felts, Jr., *Executive Director, Hospital and Child Care Sections, Duke Endowment*
Loretta Ford, *Dean, School of Nursing, University of Rochester*
John H. Knowles, *President, Rockefeller Foundation*
Ben N. Miller, *Physician, Columbia, South Carolina*
A. Glenn Morrow, *Chief, Cardiovascular Surgery, National Institutes of Health*
Raymond D. Nasher, *The Raymond D. Nasher Company*
Frank W. Putnam, *Professor of Zoology, Indiana University*
William R. Pitts, *Physician, Charlotte, North Carolina*
Henry E. Rauch, *Vice Chairman, Board of Trustees, Duke University*
June S. Rothberg, *Dean, School of Nursing, Adelphi University*
John M. Russell, *Past President, The John and Mary R. Markle Foundation*
Anne R. Somers, *Associate Professor of Community Medicine, Rutgers Medical School*
Mitchell W. Spellman, *Dean, Charles R. Drew Postgraduate Medical School*
Richard J. Stull, *Executive Vice President, American College of Hospital Administrators*

1

General Information

Duke University

Duke University is at once one of the youngest of the major private universities in the United States, and one of the older institutions of private learning. In 1839 a group of citizens from Randolph and adjacent counties assembled in a log schoolhouse to organize support for a local academy founded a few months earlier by Brantley York. Prompted, they said, by "no small share of philanthropy and patriotism," they espoused their belief "that ignorance and error are the banes not only of religious but also of civil society which rear up an almost impregnable wall between man and happiness." The Union Institute which they then founded was reorganized in 1851 as Normal College to train teachers, and again in 1859 as Trinity College, a liberal arts college which in 1892 moved from the fields of Randolph County to the growing city of Durham, North Carolina. It was this college which James B. Duke selected as the major recipient of a fortune which he had begun to make in this same city, when, in 1924, with a gift of great munificence he provided endowment funds for the university that would bear his name.

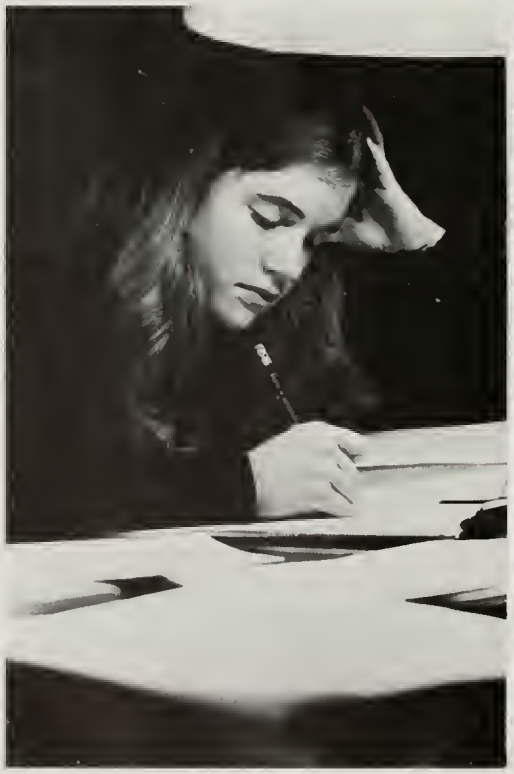
The name Trinity remains in the undergraduate college of arts and sciences. The old Trinity College had, like almost all institutions in America at the time in which it was founded, been restricted to men. In 1896, Washington Duke gave an endowment upon the condition that women be admitted "on equal footing with men," and in 1930 The Woman's College was established as a separate, coordinate college. For over forty years, these coordinate colleges continued, with instruction being offered by the University faculty, but with residents remaining a mile apart, the women on East Campus, the site of old Trinity College, and the men on West Campus, the site of the newer Duke University buildings begun in 1924. In order to assure that women were indeed admitted "on equal footing with men," and to recognize that the education which men and women had received at

Duke had long taken place in the same classrooms, the University merged these coordinate colleges in 1972 to form Trinity College of Arts and Sciences, an administrative unit responsible for undergraduate admissions, programs of instruction, academic and personal counseling, and residential life.

As early as 1851, Normal College included courses in surveying, architecture, and engineering. Separate departments of civil, electrical, and mechanical engineering were established later, and in time these three departments were grouped administratively to form, first, the Division, then the College, and finally in 1966 the School of Engineering in recognition of its professional status at both undergraduate and graduate levels. In 1967 a division of biomedical engineering was added and jointly sponsored by the Medical School. In 1971 it was given departmental status. All four departments offer courses leading to the B.S.E., M.S., and Ph.D. degrees.

The School of Nursing was established in 1931 in association with the School of Medicine and Duke Hospital. The three-year curriculum led to the Diploma in Nursing. After 1938 any student who also completed two years of acceptable college work was awarded a Bachelor of Science degree as well. A four-year program leading to the degree of Bachelor of Science in Nursing was approved by the University Board of Trustees in 1953, when the School of Nursing was incorporated into the Division of Health Affairs.

In Trinity College of Arts and Sciences and the Schools of Engineering and Nursing, instruction is largely offered by university faculty who engage in research, and in graduate and undergraduate teaching. Duke offers its undergraduates the opportunity to study with many internationally recognized authorities in their disciplines, and with faculty members who are jointly committed to undergraduate



nstruction and to advancing the frontiers of knowledge. The University recog-izes that students learn not only through formal lectures, but also through he interplay of ideas among faculty members and students; thus, it offers ndergraduates the opportunities both to test their ideas against those of their rofessors and to observe at close range those who have committed their areers to the academic life. At the same time it recognizes that students should earn much from one another, and most of all should look to themselves as hey undertake to fulfill the Socratic maxim, "know thyself."

esources of the University

As the University has developed around the core of undergraduate col-eges and schools, the Graduate School has expanded in numbers of students nd in areas of instruction and research; the School of Law of Trinity College ecame the Duke University School of Law; and other professional schools ere established. The Divinity School was organized in 1926, the School of Medicine in 1930, the School of Forestry in 1938, and the Graduate School of Business Administration in 1969.

The Faculty. A university faculty of over 1,050 maintains a tradition of per-onal attention to students. Many members of the faculty are or have been national leaders in their various professional organizations, as well as con-sultants to industry, government, or foundations, and their contributions to scholarship include many publications growing out of research. To honor out-standing faculty members, the University has established more than thirty James B. Duke professorships, in addition to other named professorships.

The Libraries. To support a rich educational experience in a world of rapid and far-reaching change, great library collections are essential. Undergraduate students at Duke are fortunate to have available exceptional resources. The University library, among the first nineteen university libraries in the country, contains 2,333,382 volumes, 4,180,000 manuscripts, and about 250,000 maps, broadsides, photographs, and materials in microtext form. In 1971–72, 110,000 volumes were added; 14,471 periodicals and 196 newspapers are received currently.

A division of photographic services, with the most modern cameras and other equipment for microfilming and photographing printed and manuscript materials, provides reading machines to serve the library's large collection of micro-text copies of rare books, periodicals, and newspapers. Comfortable reading and study rooms are provided also for those consulting rare books, manuscripts, government publications, newspapers, and periodicals.

The library on East Campus (formerly Woman's College Library) contains 199,600 volumes in an open stack collection, chiefly those books most frequently used in the undergraduate curriculum. The School of Engineering also maintains its own library which contains 49,000 volumes and 500 periodicals. As part of the Medical Center Library, the School of Nursing has a reference library of over 7,000 books, current periodicals, and audiovisual materials located in Hanes House. The School of Medicine Library contains over 90,000 volumes and 1,600 current periodicals and is open to nursing students.

Undergraduates in the undergraduate schools and college have access to additional departmental and professional school libraries plus those of nearby libraries through inter-library loan.

Science Laboratories. In addition to the teaching and research laboratorie in the departments of natural and social sciences, and in the Schools of Engineering and Nursing, there are other facilities in which some advanced undergraduates work on individual projects. These include the Duke Universit Marine Laboratory in Beaufort, North Carolina; the Highlands Biologica Laboratory in Highlands, North Carolina; the phytotron facility on the Duk campus; the Duke Forest adjacent to the campus; and the Triangle Universitie Nuclear Laboratory, also on the campus.

School of Nursing Instructional Facilities. Facilities for instruction in th School of Nursing include resources in the undergraduate college as well as i professional and graduate schools of Duke University and in the clinical facilitie of Duke Hospital, Durham Veterans Administration Hospital, Durham Healt Department, John Umstead Hospital, and numerous other health agencies i the vicinity.

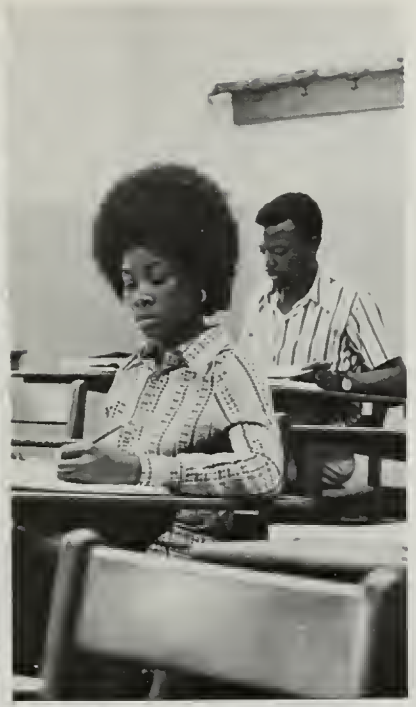
"The Past is Prologue"

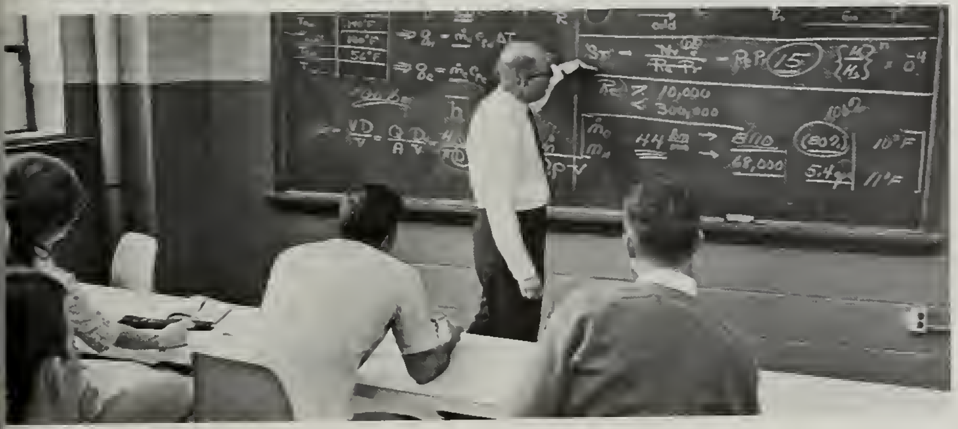
From academy to university some of the basic principles have remaine constant. The Duke University motto, *Eruditio et Religio,* reflects a fundamental faith in the union of knowledge and religion, the advancement of learning, the defense of scholarship, the love of freedom and truth, a spirit o tolerance, and a rendering of the greatest service to the individual, the state the nation, and the church. Through changing generations of students the objective has been to encourage each individual to achieve to the extent of hi capacities an understanding and appreciation of the world in which he lives his relationship to it, his opportunities, and his responsibilities.

Duke, a privately supported, church-related (Methodist) university, ha about 8,400 students enrolled in degree programs, college, and schools. Thes students annually represent nearly every state and sixty foreign countries; ther are now more than 47,000 alumni in all fifty states and in many foreig countries. The University is a member of the North Carolina and Souther Associations of Colleges and Schools, and of the Association of American Universities.

Purposes of the Undergraduate College and School

Trinity College of Arts and Sciences. The undergraduate liberal art student in Duke University has many options of residential life and curricula and cocurricular programs. The curricular offerings, the educational facilities and the University faculty of arts and sciences within Duke University provide students a maximum opportunity for the development of special interests an talents. The cocurricular programs and activities in the living units reinforc curricular offerings and provide various ways of bringing students and facult together. Living units and classes are on both campuses. Buses, subsidized b the University, circulate through both campuses, thereby making access t facilities readily available. Residential units include those for women, those fo men, as well as units for men and women on separate floors or halls. Living learning interest groups occupy parts or all of some residential units; in othe instances, such groups as fraternities, men's dormitories, and women's dormitorie have joined in federations to sponsor shared academic and co-curricular programs.





School of Engineering. The undergraduate engineering program at Duk University is designed both for students who intend to become professiona engineers and for those desiring a modern, general education, based on th problems and the promises of a technological society. The environment i which students are educated is as important in shaping their future as thei classroom experiences. In the Duke School of Engineering, this environmen has two major components: an environment of modern technology derive from the research and design activities of faculty and students in the School and the liberal arts environment of the total University, with its humanitarian social, and scientific emphases.

Engineering is not a homogeneous discipline; it requires many specia talents. Some faculty members in the School of Engineering are designers; the are problem-oriented, concerned with teaching students how to solve problems— how to synthesize relevant information and ideas and apply them in a creative feasible design. Other engineering faculty members function more typically a scientists; they are method-oriented, using the techniques of their discipline i their teaching and research to investigate various natural and man-made phenomena.

Engineering students at Duke develop the facility to reason and to communicate in at least two "languages"—English and mathematics, and they learn to understand man in both a private and a social context so they can appl technology to help improve the quality of life.

School of Nursing. The School of Nursing is committed to promoting human health and welfare through providing foundations for knowledgeable nursing services and is committed to contributing to the attainment of the University's aims of teaching, research, and public service. In support of this the School of Nursing aims to prepare its graduates to function as practitioners

of professional nursing in roles most appropriate to the level of their preparation. The School also aims to provide its students with an educational background which will serve as a basis for advanced study in nursing in addition to continued professional and personal growth.

The faculty of the School of Nursing believes in the concept that a professional nurse is a person who has acquired the specialized knowledge of nursing, who has attained abilities useful in the practice of nursing, and who has developed attitudes appropriate to the profession of nursing.

The faculty conceives professional nursing to be a service which contributes to the health and well-being of people. Professional nursing practice is interacting with human beings under stress, frequently over long periods of time; providing comfort and support in times of pain, anxiety, loneliness, and helplessness; using the nursing process to make judgments in establishing, implementing, maintaining, and/or modifying a plan of health care; and knowing when and how to use existing and potential resources to help patients toward recovery and adjustment. Professional nursing practice is sharing responsibility for the health and welfare of all those in the community; participating in programs designed to prevent illness and maintain health; coordinating professional and technical services in the best interest of patient care; and supervising, teaching, and directing those who give nursing care. Professional nursing practice requires constant evaluation; asks questions and seeks answers which will add to the body of nursing knowledge; and transmits and uses this knowledge, including research findings, to improve health services to people. Professional nursing practice requires knowledge and skill of a high order and provides opportunities for personal and professional fulfillment.

The faculty believes that the primary aim of nursing education is to provide an environment in which the student can develop self-discipline, intellectual curiosity, the ability to think critically, and acquire knowledge and skills necessary for practice. It believes that learning is manifested by change of behavior, resulting from experience; that an atmosphere for learning is offered in a climate which encourages self-direction and creativity; that the student who seeks admission to the School comes with the intent of practicing professional nursing; and that the curriculum offered aids the student in realizing this intent and in stimulating the desire for continued professional growth.

2

Degree Programs

Degrees Offered

Duke University offers, in Trinity College of Arts and Sciences, programs of study which lead to the degrees of Bachelor of Arts and Bachelor of Science; in the School of Engineering, the degree of Bachelor of Science in Engineering; and in the School of Nursing, the degree of Bachelor of Science in Nursing.* Within the four-year curriculum of each college or school, the student has the major responsibility for devising and carrying through a course program appropriate to his goals and background. He is assisted in this task by departmental directors of undergraduate studies, supervisors of freshman instruction, faculty advisers, and by the academic deans of his school or college.

Trinity College of Arts and Sciences

In the arts and sciences curriculum there are two programs leading to a bachelor's degree. Within both programs students may major in one of the following subjects or in approved interdepartmental programs: accounting, anthropology, art, Black studies, botany, chemistry, classical studies, comparative area studies, comparative literature, computer science, economics, elementary-school education, English, French, genetics, geology, German, Greek, history,

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*No student may earn both the Bachelor of Arts and the Bachelor of Science degree in Trinity College of Arts and Sciences. After qualifying for an A.B. or a B.S. degree in a program offered by Trinity College of Arts and Sciences, however, a student may apply for transfer to an undergraduate professional school at Duke. If admitted, he may undertake prescribed additional undergraduate work to qualify for a baccalaureate degree in nursing or engineering. Likewise, a student who has earned a baccalaureate degree in nursing or engineering at Duke may apply for transfer to Trinity College of Arts and Sciences and undertake prescribed additional undergraduate work to qualify for a baccalaureate degree in arts and sciences. (See *Change of Status*, page 46.)

Latin, management sciences, mathematics, medieval and Renaissance studies music, philosophy, physical education for women, physics, political science psychology, public policy studies, religion, Russian, science education, sociology Spanish, and zoology. In addition to completing a major, a student must complete courses in other divisions of the curriculum and satisfy requirements relating to quality of academic work and residence. A portion of the curricular and credit requirements for both the A.B. and B.S. degrees may be satisfied through the Advanced Placement Program of the College Entrance Examination Board undertaken before enrollment in a college or school.

Both academic programs described below lead to either the A.B. or B.S. degree and provide two distinct approaches to a liberal arts education—Program I and Program II. To graduate with either the A.B. or B.S. degree in Program I or Program II, a student must satisfactorily complete at least thirty-two semester-courses, or their equivalent in an approved curriculum. Ordinarily each semester-course involves three or more hours of academic instruction a week throughout the semester. Parts and multiples of the semester-course are also recognized, such as half-courses and double-courses. (Whenever the term *course* appears in this *Bulletin,* reference is to a semester-course unless otherwise indicated.)

PROGRAM I: CURRICULAR REQUIREMENTS

Program I provides a flexible approach to the A.B. or B.S. degree by enabling a student to choose, within broadly stated requirements, that particular academic subject matter which best satisfies his intellectual interests and educational goals. Although specific requirements exist regarding proficiency in English composition and in physical activity, optional methods of satisfying those requirements are provided. Through a variety of small-group learning experiences and independent study, Program I assures each student the opportunity to undertake at least a portion of his undergraduate study in closer association with faculty and fellow students than may normally be provided in regular classroom instruction and large lectures. A detailed description of Program I is given below, with requirements for graduation explained in terms of curriculum, course credits, grade-average, and residence.

Distribution of Courses. Program I enables a student to achieve breadth of academic and intellectual experience by requiring that he complete a number of semester-courses in each of the three divisions into which the academic departments of the arts and sciences are grouped. The courses selected in each division must be those in which the essential subject matter and substance of the discipline are presented. An interdepartmental or interdivisional course may not be used to satisfy divisional requirements unless it is cross-listed in a department; nor may a course offered by a professional school, or an introductory skill course, be so used. Courses offered in one division may not be used to satisfy distributional requirements in another division, but courses used to satisfy small-group learning experiences may be used to satisfy distributional requirements. (See the sections that follow concerning skill courses and small-group learning experiences.) The three divisions and the academic departments within each are:

Humanities. Art, Classical Studies (including Greek and Latin), English, Germanic Languages and Literature, Music, Philosophy, Religion, Romance Languages (including French, Italian, Portuguese, and Spanish), and Slavic Languages and Literatures (including Russian).

Natural Sciences and Mathematics. Botany, Chemistry, Computer Science, Geology, Mathematics, Physics, and Zoology.

Social Sciences. Anthropology, Economics, Education, Health and Physical Education for Women, History, Management Sciences, Political Science, Psychology, and Sociology.

Courses taken on the pass fail basis do not satisfy the distributional requirements except for independent study or internships that are offered only on a pass/fail basis. A student must successfully complete courses in each of the three divisions as follows:

First division. Each student must concentrate (or major) in a single discipline or in an interdisciplinary program. He is required to take a number of courses in that discipline or in that interdisciplinary program, as determined by the department or departments concerned. In so doing he will automatically complete courses in one of the three divisions described above. The division of the concentration (or major) is called the first division (see below page 14.)

Second division. A student must pass at least four semester-courses in a second division of his own choice. To satisfy this requirement, all four courses may be selected from one department within the division, or the four courses may be distributed among two or more departments. At least two of the four courses must be at the advanced level. (See pp. 14-15 regarding advanced work.)

Third division. A student must pass at least two semester-courses in a third division of his own choice. The courses may be at the introductory or advanced level. Both courses may be taken in one department within the division, or one course may be selected from each of two departments. In the latter case, however, a student should first determine that the course chosen is not part of a sequence of two courses (a so-called hyphenated course), both of which must be taken to obtain credit for either course.

Skill Courses. As noted previously, there is one general limitation upon the choice of courses for distributional purposes. Elementary skill courses may not be used to satisfy the distributional requirements in any of the three divisions. For instance, neither English composition nor elementary foreign language courses count as courses in humanities, because developing skill in composition or speech is different from encountering linguistics or literature. Skill courses are listed below. In planning course selections to meet distributional requirements, students should consult this list, not for purposes of avoiding such courses but rather to assure that courses chosen to meet distributional requirements actually serve that purpose.

Skill Courses That Do Not Satisfy Distributional Requirements of Program I

Art	53-54
Chinese	101-102 (UNC-CH); 131, 132; 133, 134
Classical Studies	Greek 1-2 Latin 1-2; 63-64
Education	105; 106; 107; 108; 151; 152; 153; 154; 161; 162; 195; 196; 201; 215; 216; 225; 226; 236; 237; 239; 246; 266; 276
English	1; 50; 65, 66; 101; 102; 103, 104; 110; 120; 130; 139

German	1-2; 63; 105; 117, 118; 181, 182
Health Education	101-102; 134; 192
Physical Education (Women)	61-62; 102; 103; 105-106; 117; 119S; 120; 132; 133; 161 162; 181; 182; 185
Physical Education (Men)	100-101; 121; 125; 126; 127; 130; 132; 133; 140; 141; 142 164; 165; 170; 171; 172; 173
Hindi-Urdu	181, 182; 183, 184
Japanese	151, 152; 153, 154
Music	7, 8; 57; 58; 59; 60; 65; 107, 108; 151; 152; 153; 154; Applied Music
Psychology	117
Romance Languages	French 1-2; 63; 64; 97; 98; 127; 150; 181-182 Italian 1-2; 63; 64; 181-182 Portuguese 181-182 Spanish 1-2; 63; 64; 97; 176; 181-182
Russian	1-2; 63-64; 81, 82
Swahili	101, 102

In addition, certain courses, e.g., military science courses and courses outside the departments of arts and sciences, do not satisfy distributional requirements since they are not included within the curricula of departments normally recognized as falling within any of the three divisions.

Proficiency in English Composition. Each student is required to demonstrate his ability to write good English either by presenting a score of 700 or higher on the College Entrance Examination Board (CEEB) English Composition Achievement Test, or by passing a semester-course (English 1) in English composition in the first semester of the freshman year. A student presenting a 700 or higher score on the CEEB Test satisfies the English composition proficiency requirement for graduation, but does not receive course credit for English 1. When the proficiency requirement is satisfied by passing English 1, that course counts among the thirty-two semester-courses required for graduation.

Proficiency in Foreign Language. Certain departments recommend or require foreign language proficiency for their majors. Candidates for the B.S. degree may be required by their major departments to be proficient in a particular foreign language.

A student may demonstrate proficiency in a foreign language by successfully completing courses at Duke, or by achieving a satisfactory score on one of the following appropriate tests: (1) CEEB Achievement Test; (2) CEEB Advanced Placement Program Examination; or (3) CEEB College Placement Test. Course credit toward graduation is given only for successfully completing language courses or for certain Advanced Placement Program work in language undertaken in high school; course credit is not given when the language proficiency requirement is satisfied by means of CEEB Achievement or College Placement Test, or a Duke proficiency test. (See pages 35-36, Advanced Placement.)

Small-Group Learning Experiences. To supplement the classroom and large lecture method of instruction, small-group learning experiences have been devised to assure the student opportunities to engage in discussion, develop skills, refine judgment, and have his ideas challenged.

A *seminar* consists normally of a group of twelve to fifteen students who together with an instructor engage in disciplined study and discussion.

A *preceptorial* is a discussion meeting between an instructor and, normally, no more than twelve students. It is an additional and optional unit attached to a regular course. It allows a student to carry his interest and learning in a particular subject further than that required in the regular class. If a regular class normally meets three times a week, the preceptorial would be a fourth one-hour meeting.

A *discussion section* is comprised of approximately ten students and an instructor in a group that is part of a regular course. It is distinguished from a preceptorial in that every student in the course participates in a discussion group, whereas the preceptorial is optional. The preceptorial is an opportunity for intensive additional study, whereas a discussion group is an integral part of a lecture course given to large groups.

A *tutorial* is a meeting between an instructor and, normally, one to five students, independent of any other course.

Courses or sections of courses offering the above small-group experiences are indicated by a suffix to the course number: *S* (for seminar), *P* (for preceptorial), *D* (for discussion section), or *T* (for tutorial).

Independent study varies according to the subject matter and research methods of the disciplines and the interests of students and their supervising professors. It may consist of extensive reading and research in the literature of a discipline, followed by the writing of a substantial paper, a laboratory research project, work in field research, or the composition of a play or a novel. A special form of independent study, particularly for departmental majors, is the preparation of a thesis or the completion of a major independent project in the junior, but more often in the senior year. For some students it provides an opportunity for integrating understanding of several disciplines. For others it permits intensive consideration of specific topics previously encountered but insufficiently explored. And for still others, it is original research and the development of new insights and knowledge. (See page 39 for procedures for enrolling in independent study.)

Learning Experience Requirements. Students are required to have the following small-group and independent learning experiences as the terms are described.

1. *Freshman and sophomore years*
    - *a.* At least one full semester-course designated as a *seminar, tutorial,* or *independent study,* or
    - *b.* A combination of two small-group learning experiences that are supplementary or complementary to semester-courses, such as *preceptorials* or *discussion sections.*
2. *Junior and senior years*
    - *a.* At least two full semester-courses designated as *seminars, tutorials,* or *independent study,* or
    - *b.* A thesis or an independent study project for which two semester-course credits are earned.

These requirements are the minimum for both the A.B. and B.S. degrees. Although a student is not prohibited from enrolling in additional small-group sections or courses or in independent study beyond the required minimum, preference will be given to those needing such learning experiences to satisfy the above requirements.

Concentration. Although students in Program I are expected to achieve breadth of intellectual experience by taking courses in each of the three divisions of learning within the University, they are also expected to acquire some mastery of a particular discipline or interdisciplinary area. Each student must, therefore, concentrate a portion of his studies in a single department or in an approved interdisciplinary program. The former type of concentration is called the *departmental major;* the latter, *interdepartmental concentration.*

Departmental Major. To pursue a departmental major, a student in Program I must pass a number of courses within the major department as specified by that department and approved by the faculty, as well as courses in other departments as may be necessary or helpful to effective performance in the major. These requirements are set forth in the section entitled *Departmental Major* following each department's course descriptions. A student should be familiar with this information when making his choice of major and review it at each registration period.

A major consists of at least five courses in one department above the introductory level. A department may not require a student for the A.B. degree to take more than eight semester-courses above the introductory level in the major, although the student may elect to do so. A department may not require a student for the B.S. degree to take more than ten semester-courses above the introductory level in the major, although the student may elect a more intensive major program. Foreign language departments may at their discretion begin their major after the elementary and intermediate courses. (See pages 41-42 for procedure for declaring the major.)

Interdepartmental Concentration. Some students in Program I may desire to pursue an interdisciplinary program in two or more departments as an alternate means of satisfying the concentration requirements. An interdepartmental concentration consists of at least three courses beyond the introductory level in each of two or more departments. Courses in other departments or demonstration of proficiency in areas relevant to the objectives of the program may be required. An interdepartmental concentration must be planned early in the undergraduate career. Students who declare interdepartmental concentrations must identify and satisfy second and third divisional requirements. (See page 42 for procedures for planning and declaring an interdepartmental concentration.)

Double Major. A student who completes requirements for the major in two departments may have both majors recorded on his official record. (See page 42 for procedures for declaring a second major.)

Advanced Work. As previously noted, a student in Program I must complete at least thirty-two semester-courses in an approved curriculum to graduate with an A.B. or B.S. degree. Of that number of courses, at least twelve must be at the advanced level. Normally, advanced-level courses are numbered in the 100- and 200-series. (Courses numbered 200 or above are senior-graduate courses. See page 39 for regulation concerning the limited eligibility of non-seniors in 200-level courses.) This requirement may be satisfied by passing advanced-level courses in any of the three divisions of learning earlier described. In satisfying the distributional requirement for the second division, a student must complete at least two advanced courses. Normally he completes a number of such courses by meeting his major or interdepartmental concentration requirements. The remainder of the twelve may be taken as courses in the major, as distributional equirements, or as electives. To determine requirements for admission to adanced courses in a particular department, a student should consult that departnent's description of its courses and prerequisites.

Physical Activity. All students are required to complete two semesters of ipproved physical activity unless excused for medical reasons. This requirement nay be met either by satisfactory completion of two semesters in appropriate hysical education courses or by an alternate form of physical activity approved y the appropriate department of physical education. The work is normally ompleted in the freshman year. Pass/fail grades are assigned for performance n required physical education courses and for alternate forms of physical acivity. Physical education courses or alternate forms of physical activity do not ount among the thirty-two courses needed for graduation. Nevertheless, each tudent must complete this requirement to be graduated. Elective activity courses or credit are available for students who have completed the requirement.

A student who has completed a full calendar year or more of active duty in the military forces of the United States may be excused from one semester of the requirement in physical education for each six months of such active duty.

Military Science Courses. No more than four courses in the military sciences may be counted among the thirty-two courses required for graduation. For students participating in either the Air Force or Naval ROTC program, the four courses for which graduation credit may be earned are normally taken in the junior and senior years. Enrollment in a few additional courses and laboratories in earlier years is required by the services to qualify for an officer's commission. Although not counted toward graduation, such additional courses, if completed, appear on a student's permanent academic record.

Residence Requirements. A residence period of four academic years, that is, eight semesters, is the normal amount of time a student may take to earn either the A.B. or B.S. degree. This period may be extended by one or two semesters when, in the opinion of a student's academic dean, legitimate reasons underlie the student's failure to be graduated in eight semesters, and it seems probable that such extension will enable the student to complete all remaining requirements for graduation. A student will not be permitted residence of more than five academic years, that is, ten semesters, in order to be graduated.

For the minimum residence period, at least sixteen courses must be satisfactorily completed at Duke. If only sixteen courses are taken at Duke, they must include the courses of the final two semesters. Students with more than sixteen courses at Duke may take two courses of the last year in another institution of approved standing. With the approval of their major adviser and their academic dean, students who have completed six full semesters of work at Duke may take four courses in their last year at another institution of approved standing. Any courses taken elsewhere must be approved by the student's adviser and academic dean.

Former students of The Woman's College who have been out of college for six or more years may take up to ten courses or thirty semester-hours of work in another institution of approved standing in final fulfillment of requirements, providing that (1) she was in good standing when she withdrew from Duke; (2) she proposes *in advance* a plan which ensures that the work to be taken elsewhere will be comparable to the work required at Duke; (3) she demonstrates that to return to Duke to complete the work for the degree would be either impossible or occasion serious hardship; and (4) she is prepared to take Duke examinations on any courses taken elsewhere if required by the department concerned.

Continuation Requirements. A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation to continue enrollment in college. A student who fails to meet the minimum requirements outlined below must leave college for at least two semesters. A summer session may be counted as a semester. Following a student's application for readmission, his return must be approved by the Associate Dean of Trinity College of Arts and Sciences. If the student thereafter fails to meet continuation requirements, he will be permanently dismissed from the College.

Satisfactory Performance Each Semester. To remain in college a student must not fail three or more courses in the first semester of the freshman year or fail two or more courses in any subsequent semester. If a student, for any special reason, has been permitted to enroll for three or fewer courses, he is required to pass all courses to remain in college.

Satisfactory Progress Toward Graduation. A student must pass in an approved curriculum at Duke the following number of semester-courses (or their equivalent in half-courses or double-courses) to continue from one academic year to a subsequent year. No more than two courses completed with *D* grades may be counted toward any of the totals. (Summer terms *at Duke* may be used to meet this requirement.)

To begin enrollment in a	a student must have passed
second year	six semester-courses
third year	fourteen semester-courses
fourth year	twenty-two semester-courses
fifth year	twenty-eight semester-courses

In addition, a student must make satisfactory progress toward fulfillment of curricular requirements.

Students are reminded that in cases where continuation is in question, incomplete work in any course is considered a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for spring semester, *or* June 15 in the summer. In the case of incomplete work in the spring semester, this requirement applies whether or not the student plans to attend one or more terms of the summer session. However, the student may not enroll in a summer term at Duke until he has satisfied continuation requirements.

Any student excluded from his college under the provisions of this regulation may at his request have his case reviewed by the Associate Dean of Trinity College of Arts and Sciences.

PROGRAM II: INDIVIDUALLY DESIGNED PLANS OF STUDY

Nature and Purpose. A second approach leading to either the A.B. or B.S. degree is Program II. In general, this program offers the student who has a special interest or talent in a single field, or an unusual combination of interests or talents in several fields, an opportunity to plan, with the counsel of a single department or an interdepartmental committee, a special curriculum of academic and related work adapted to the exceptional qualities the student possesses. Together, the student and his departmental Program II adviser design an individual plan of work for the whole or the remainder of the student's college career. They assess his background, needs, and ambitions and evaluate the resources of the University and those outside it as means of satisfying those ambitions. They consider what academic courses would be useful, but also consider other options. For example, a full semester or year of independent study, equivalent to a normal course-load under Program I, might be agreed upon for a work-study program off-campus, or a period of study abroad might seem most pertinent. Regardless of the features of an individually designed curriculum, each is tailored to the special interests and talents of the student for whom it is designed.

Admission. A student interested in being considered for Program II may confer first with his academic dean about his eligibility for the program, or he may confer directly with the director of undergraduate studies in the department closest to his interest. If he appears eligible for Program II, the director, other adviser, or an interdepartmental committee will counsel with the student about the design of his curriculum. When an interdepartmental committee is needed, one department will bear administrative responsibility. The curriculum must be approved by the department and also by the Committee on Program II of the Undergraduate Faculty of Arts and Sciences. Upon endorsement by that committee, it becomes an obligation assumed by the student, though it may later be modified with the approval of the department and the Committee on Program II. A description of the plan is sent to the student's academic dean, and each semester the student's progress in achieving the plan is also reported.

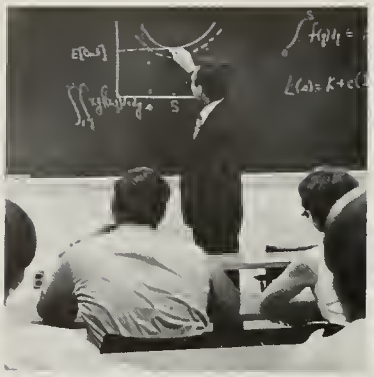
Until formally designated a student in Program II, a student should register for courses and satisfy the curricular requirements of Program I. Upon acceptance into Program II, a student is relieved of most, but not all, requirements expected of Program I students. Should he leave Program II for any reason, he assumes all requirements of Program I.

Normally, a student will be accepted into Program II only after he has been in residence at Duke for one or two semesters and has shown during that period that he possesses the necessary qualifications for admission. A transfer student or a freshman who believes that he qualifies for Program II and desires to be admitted in his first semester at Duke is invited to write the dean concerned with freshman orientation in Trinity College of Arts and Sciences before matriculation, providing him with a complete statement of his qualifications and plans as a prospective Program II student.

General Requirements. Apart from the requirements arising from his approved plan of work, a Program II student must satisfy certain general requirements which are also applicable to students in Program I. These requirements have been set forth in the foregoing explanation of Program I, under the following headings: Course Requirements for Graduation, see page 10; Physical Activity, see page 15; Military Science Courses, see page 15; Residence Requirements, see page 15. Although the normal and maximum periods of residence apply to students in Program II, the requirements relating to the last two semesters may be adjusted to suit the student's approved plan of work.

SPECIALIZED UNDERGRADUATE PROGRAMS LEADING TO PROFESSIONAL CAREERS

An undergraduate may supplement his major to prepare for certification in one of several professions. The following programs of study offer some guidelines.



Accounting. A student may specialize in public or industrial accounting in his junior and senior years. The following sequence of courses is recommended as preparation for certification as a professional accountant.

Freshman Year
Mathematics 31 and 32, *Introductory Mathematical Analysis*
Management Sciences 50, *Elementary Theory of Economic Enterprise*

Sophomore Year
Management Sciences 55, *Quantitative Analysis for Business*
Mathematics 51 or develop competence in computer operations
Management Sciences 120, *Organization Theory*
Management Sciences 130, *Information Systems*
Management Sciences 140, *Operations Research*

Junior Year
Management Sciences 110, *Statistics for Management Decisions*
Management Sciences 210, *Intermediate Theory of Economic Enterprise*
Management Sciences 230, *Controllership*
Management Sciences 231, *Financial Accounting*

Senior Year
Management Sciences 232, *Internal Control and Auditing*
Management Sciences 233, *Federal Income Taxation*
Management Sciences 234, 235, and 236, *CPA Preparation*

Teaching. Duke University is accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and second-ry school teachers. The University's programs are also approved by the North arolina Department of Public Education.

The program for students who intend to teach is designed to prepare for ositions either in elementary or secondary schools. Prerequisites for all prospective eachers are Psychology 92, 93, 94, or 95, preferably during the sophomore ear, and Education 100 or 113, preferably during the junior year. Only students ith a *C* average overall and in their major or teaching fields will be admitted student teaching. Special methods courses should be taken prior to undergraduate student teaching, which is part of a planned professional semester in he senior year.

Elementary Education. A major in this program is designed for those tudents who desire to meet the certification requirements for teaching in the lementary school.

Required General Education Courses

English	1 course or by examination
Foreign language	Second year (or equivalent) or two courses in fine or practical arts
Biological science	2 courses
Mathematics 31	1 course
History 91-92	2 courses
Political Science 61	1 course
Economics 115 or 120	1 course
Literature	1 course
Psychology 92, 93, 94, or 95	1 course

Required Specialized Subject Matter Courses

Physical Education (for Early Childhood or Intermediate Grades)	½ course
Physical Education 102	½ course
Health Education 134	½ course
Music Education 151-152	1 course
Education 161-162	1 course
Education 105	½ course
Education 106	½ course
Education 107	½ course
Education 108	½ course

Required Professional Courses

Education 100 or 113	1 course
Education 118	1 course
Education 195S	½ course
Education 196S	1½ courses

A major in elementary education must include the concentration of at least six courses in subjects commonly taught in elementary school, chosen from one of the divisions—humanities, natural science, or social science. The concentration may include courses from the general education requirement.

Secondary-School Teaching. Whatever their majors, students preparing to teach must consult an appropriate member of the Department of Education prior to each registration period to assure that they will be eligible to enter the required student teaching program. Students preparing to teach in a secondary school meet certification requirements by qualifying in one teaching field. Prospective secondary-school teachers must major in a subject other than education. Qualifications for certification to teach a single science may be sought under either the A.B. or the B.S. degree. Students desiring to major in science education should read carefully the description of that program given below.

Science Education. Students intending to teach sciences in secondary schoo may major in science education. The program meets certification requiremen and provides a broad background in several sciences. Early consultation with a adviser in the Department of Education and a selected department in science c mathematics is required. Five courses in education (100 or 113, 118, 215S, 216 246 or 276) are required. The Science Education program provides the require two courses in mathematics and laboratory work in at least three sciences, wit concentration in one of these. University curriculum requirements account fo a maximum of fourteen courses. The remaining eighteen are selected to provid breadth in at least three sciences and must include a minimum of four advance courses. The general and professional courses required for certification may b met in part both by the University curriculum distribution and within the eightee courses devoted to concentration.

A major in science education leads to an A.B. degree within the norma thirty-two course limit. Students wishing to have the B.S. degree may expect t take more than thirty-two courses. The normal number of courses may be reduce by advanced placement or proficiency tests in English and foreign language.

PREPARATION FOR GRADUATE AND PROFESSIONAL SCHOOLS

Many graduate and professional schools require special tests for student seeking admission. Information regarding the test requirements should be obtained from the catalogues of the schools to which the student plans to apply. The University Counseling Center has available applications for required graduate and professional testing programs.

Graduate Schools of Arts and Sciences. The student who plans to ente a graduate school of arts and sciences for advanced study should consult ar adviser in the field of the proposed advanced study concerning suitable preparation Most graduate schools have definite requirements in foreign languages for all students. Candidates for the degree of Doctor of Philosophy may be required tc pass reading examinations, usually in German and French. In some cases other languages may be substituted. As soon as practicable, the student should ascertain the requirements of the particular graduate school he desires to enter.

Graduate Schools of Engineering. Students interested in the possibility of graduate work in engineering should consult the Dean of the School of Engineering or the director of graduate studies in one of the four engineering departments. Most engineering graduate schools require that a candidate have the equivalent of a Bachelor of Science in Engineering degree, but it may be possible for students in the natural and social sciences to obtain conditional admission if they have a sufficient background in mathematics and a desire to apply science to the solution of problems.

Graduate Schools of Business Administration. Students seeking advice concerning preparation for entrance to a graduate school of business administration may consult the Department of Management Sciences. Many graduate programs in business administration are designed specifically for students with little or no undergraduate work in business.

Some schools require at least one year of calculus for admission. Additional courses in mathematics can be very helpful, especially linear algebra, probability, statistics, and advanced calculus. Other areas in which work can be of special value are philosophy of science and formal logic; one or more of the behavioral sciences, economics, and the physical sciences; and engineering.

Medical and Dental Schools. Students planning to enter a medical or ental school should arrange their programs of study from the first semester so as o include those courses required by the professional schools of their choice. These ourses usually include at least one year of English, two years of chemistry, and ne year each of biology, mathematics, and physics. At Duke University the ourses normally taken are English 1 and one or more literature courses; Chemisry 11, 12, 151, and 152; Biology 11-12 or 14 and one upper-level course with laboratory in zoology; Mathematics 31-32; and Physics 51-52. Most profesional schools require ninety semester hours of college credit before consideration or admission. Because individual medical and dental schools strongly recommend r, in some cases, require specific courses in addition to those listed above, it is vise for the student to be fully aware of any additional requirements established y the professional school of his choice. This applies in particular to schools of eterinary medicine, many of which require or recommend additional courses. A umber of medical schools require a foreign language.

The student should plan his program to meet major and graduation requirenents. He may elect to major in the department of his choice, but should discuss is program with the premedical adviser, his major adviser, and his academic dean.

Law Schools. Students who plan to prepare for law school should seek readth in their undergraduate course program with specialization in one or more reas. They may choose virtually any field for their major work. Though no pecific courses are required, pre-law students have often chosen from among the ollowing courses: Management Sciences 100; Economics 51, 52; English 55, 56; History 1, 2 or 51, 52, 91 and 92, 105, 106; Philosophy 41 and 48; Political Science 61; Sociology 91; Engineering 169, 170.

For a fuller discussion of undergraduate preparation for the study of law, students should refer to the *Bulletin of the School of Law.*

Theological Schools and Religious Work. The student contemplating theological study should correspond at the very earliest opportunity with the school or schools to which he intends to apply and with the authorities of his church in order to learn what will best prepare him for the specific program he expects to enter. He will be likely to find under the guidance of the seminary that he should consider the following subjects:

English language and literature; history, including non-Western cultures as well as European and American; philosophy, particularly its history and its methods; natural sciences, both the physical and the life sciences; social sciences, where psychology, sociology, and anthropology are particularly appropriate; the fine arts and music, especially for their creative and symbolic values; Biblical and modern languages; religion, both in the Judaeo-Christian and in the Near and Far Eastern traditions.

Some seminaries require Greek or Hebrew for admission, and many advanced Biblical courses are offered in the original tongues; modern languages have a less direct but immensely educative role and are required at the graduate studies level.

It is the understanding gained in these fields rather than the total of credits or semester hours which is significant.

In many seminaries students who have been well prepared in religion and equipped with the tools of theological study will be set free, not to complete their theological course more quickly, but rather to pursue more advanced studies. The principle constantly to be kept in mind is not that of satisfying paper regulations and minimum requirements, but of making the most of opportunities for education.

UNDERGRADUATE-PROFESSIONAL COMBINATION PROGRAMS

The provision whereby a senior may elect the work of the first year in a professional school of the University shall apply solely to *eligible students in Trinity College of Arts and Sciences*. The privilege of completing a combined course for the degree is conditional upon admission to the professional school at the close of the junior year. A student thus admitted registers as a first-year student in the professional school.

Forestry. Preprofessional training in forestry is offered to men and women who are planning careers in professional forestry. A student who has completed a three-year program of studies in liberal arts and sciences and who has maintained a satisfactory academic record may, with the approval of the dean of his college and the School of Forestry, transfer to the School of Forestry. A candidate will be expected to satisfy all divisional requirements as well as the course work expected of rising seniors in his major. Upon the satisfactory completion of the forestry courses ordinarily required in the first year in the School of Forestry (see *Bulletin of the School of Forestry*), the student will be eligible for the degree of Bachelor of Science from Duke University.

The professional degree of Master of Forestry may be earned upon satisfactory completion of three additional semesters in the School of Forestry.

Students interested in this combined course are encouraged to consult with the Dean of the School of Forestry.

Law. A student with a distinguished academic record who has completed three years of undergraduate work, or is within two semesters of graduation including the course requirements for the A.B. degree and work of the junior year in his major and related fields, may, with the approval of the dean of his college, transfer to Duke University School of Law and be eligible for the A.B. degree from Duke University upon completion therein of the work of the first year.

However, study in the Law Combination Program is contingent upon admission to the Duke University School of Law which usually requires an undergraduate degree as a prerequisite for admission. Only in unusual occasions of proved academic excellence will the Law School admit a student after the completion of his junior year.

It is understood that this program shall apply solely to eligible undergraduates who have completed three years in residence in Duke University, and that not less than the full first-year's work of the Law School will be acceptable for credit toward the bachelor's degree.

Medicine. The B.S. or A.B. degree may be awarded to certain students who successfully complete (1) twenty-four courses of undergraduate study in an approved curriculum within arts and sciences at Duke University and (2) the first year of medical study in the Duke Medical School. Such candidates are to satisfy the requirements of a departmental or interdepartmental major in arts and sciences as well as divisional requirements, or to complete satisfactorily an approved curriculum in Program II. Candidates must apply for approval through the Dean of Trinity College of Arts and Sciences after two years at Duke but before transfer to the Medical School.

The School of Engineering

Duke University offers in the School of Engineering programs of study which lead to the degree of Bachelor of Science in Engineering (B.S.E.), with majors in the Departments of Biomedical, Civil, Electrical, and Mechanical Engineering. Special programs of study in interdisciplinary fields (see page 28) eading to the B.S.E. degree may be arranged with approval of the engineering aculty. The curriculum in each of the engineering departments is accredited by he Engineers' Council for Professional Development.

For graduation with a Bachelor of Science in Engineering degree, a student must complete successfully a minimum of 32 semester-courses plus two physical education activity courses. These 32 semester-courses must include the ollowing:

General Requirements

English	1 s.c.	This requirement is met by completing English 1.
Mathematics	4 s.c.	This requirement is met by completion of Mathematics 31, 32, 73, and 74.
Natural Science	3 s.c.	This requirement is met by completing Chemistry 11 and Physics 51 and 52.
Social Sciences and Humanities	4 s.c.	This requirement is met by completion of four courses from at least two departments in the humanities and social sciences. This program of courses should reflect a rationale or fulfill an objective appropriate to the engineering profession. Courses selected must be those which present essential subject matter and substance of the discipline; for example, no introductory skill courses may be used to satisfy this requirement. Likewise, courses devoted primarily to subjects such as accounting, industrial management, finance, personnel administration, introductory language, and ROTC normally do not fulfill this objective regardless of their general value in the total engineering curriculum.
Engineering and Applied Sciences ..	3 s.c.	This requirement is met by completion of at least one course from each of three of the following four areas: electrical science, materials science, mechanics, and thermal science. See departmental requirements, which follow, for any specific courses to be included.
Digital Computation		Students are expected to have acquired a digital-computer programming capability before their sophomore year. The programming capability may be satisfied by prior experience or by passing Engineering 31, Mechanical Engineering 31, or Computer Science 51.

Departmental Requirements

Departmental Specifications	17 s.c.	The department administering the major field study will specify the nature of this requiremen In general it will consist of both required cours and electives to be planned in consultation wit the departmental adviser. See the individual departmental requirements, which follow.
*Total Minimum Requirement	32 s.c.	

Program of Studies for the Freshman Year

First Semester	*Courses*	*Second Semester*	*Course*
Chem 11—Principles of Chem.	1	Physics 51—General Physics	
English 1—Freshman Composition	1	Math 32—Introd. Math. Analysis ..	
Math 31—Introd. Math. Analysis ..	1	Elective†	
Elective†	1	Elective†	
PE—Physical Education		PE—Physical Education	
	4‡		4

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* A maximum of two semester-courses of junior or senior level air science or nav science course work may be counted in satisfying the minimum requirements of 32 semeste courses for a baccalaureate degree in engineering. These courses must be included in the 1 semester-courses listed under departmental requirements. All other courses completed in a science or naval science are taken in addition to the minimum program.

†Each student is encouraged to plan a program designed for his individual needs. H faculty adviser will be available to assist him beginning with the opening of Freshman Wee Advice should be sought relative to the most effective use of electives in relation to the speci requirements of the various engineering majors.

It should be noted that students are expected to have acquired a digital-compute programming capability before their sophomore year.

‡The normal load each semester is four courses (or an equivalent combination o courses). This is the minimum program ordinarily permitted. Engineering students takin air science or naval science may need to schedule a course in military science as supplement to the normal load.

Biomedical Engineering Departmental Requirements

The general requirements and departmental requirements are all incorporate in the following sequence. This is only one of several possible sequences. The stu dent is encouraged to choose electives and select a sequence which serves matur educational needs.

Freshman Year

First Semester	*Courses*	*Second Semester*	*Course*
Chem 11—Principles of Chem.	1	Chem 12—Principles of Chem.	1
English 1—Freshman Composition	1	Biol 14—Introd. to Biology	1
Math 31—Introd. Math. Analysis ..	1	Math 32—Introd. Math. Analysis ..	1
CPS 51—Introd. to Digital Comp. ..	1	Soc Sci or Humanities Elective	1
PE—Physical Education		PE—Physical Education	
	4		4

Sophomore Year

First Semester	*Courses*	*Second Semester*	*Courses*
Physics 51—General Physics	1	Physics 52—General Physics	1
Egr 72—Introd. to System Dynamics	1	BME 112—Biol. Syst. Analysis	1
Math 101—Interm. Math Analysis	1	Math 102—Interm. Math. Analysis	1
Egr 83—Structure and Properties of Solids	1	Soc Sci or Humanities Elective	1
	4		4

Junior Year

First Semester	*Courses*	*Second Semester*	*Courses*
Math Elective	1	BME 164—Biomed. Electronics and Measurements II	1
BME 163—Biomed. Electronics and Measurements I	1	BME 172—Biomed. Transfer Proc.	1
Egr 122—Transport Phenomena	1	Approved Elective	1
Chem 101—Phys. and Quant. Chem.	1	Soc Sci or Humanities Elective	1
	4		4

Senior Year

First Semester	*Courses*	*Second Semester*	*Courses*
BME 181—Biomedical Modeling	1	Approved Elective	1
Biology Elective	1	Approved Elective	1
Approved Elective	1	Approved Elective	1
Soc Sci or Humanities Elective	1	Soc Sci or Humanities Elective	1
	4		4

Civil Engineering Departmental Requirements

The general requirements and the departmental requirements are all inco porated in the following typical program.

Freshman Year

First Semester	*Courses*	*Second Semester*	*Course*
Chem 11—Principles of Chem.	1	†CE 16—Surveying	½
English 1—Freshman Composition	1	†Egr 11—Visual Communication	½
Math 31—Introd. Math. Analysis	1	Physics 51—General Physics	
‡Approved Elective	1	Math 32—Introd. Math. Analysis	
PE—Physical Education		‡Approved Elective	
		PE—Physical Education	
	4		

Sophomore Year

First Semester	*Courses*	*Second Semester*	*Course*
*Egr. 75—Mechanics of Solids	1	EE 63—Electric Networks	
Math 101—Interm. Math Analysis	1	Egr 83—Structure of Properties of Solids	
Physics 52—General Physics	1	Math 102—Interm. Math Analysis	
‡Approved Elective	1	‡Approved Elective	
	4		

Junior Year

First Semester	*Courses*	*Second Semester*	*Course*
CE 131—Struct. Anal. I	1	CE 123—Water Resources Egr.	
Egr 123—Dynamics	1	CE 133—Struct. Design I	
Egr 145—Fluid Mechanics	1	Egr 104—Heat Transfer and Thermodynamics	
‡Approved Elective	1	‡Approved Elective	1
	4		

Senior Year

First Semester	*Courses*	*Second Semester*	*Courses*
CE 124—Environmental Egr.	1	CE 116—Transportation Egr.	1
CE 134—Struct. Design II	1	‡Approved Elective	1
CE 139—Introd. to Soil Mech.	1	‡Approved Elective	1
‡Approved Elective	1	‡Approved Elective	1
	4		4

*Students having completed CE 23 should substitute CE 73 for Egr 75.

†May be taken in the fall or spring semester of the freshman or sophomore year.

‡Part of a program of elective courses planned with departmental approval to suit the interests and abilities of the individual student. In addition to satisfying the social science-humanities requirement of the School of Engineering, the program must include a minimum of one elective course in natural science. The program should also include a minimum of three *emphasis electives*, designed to reinforce the student's major area of study; at least one emphasis elective must be a civil engineering course.

Electrical Engineering Departmental Requirements*

athematics	1 s.c.	Mathematics elective beyond Math 102.
asic Science	1 s.c.	Basic science elective (in addition to 3 s.c. in natural science listed under general requirements).
ocial Sciences and Humanities	2 s.c.	Social sciences-humanities elective (in addition to 4 s.c. listed under general requirements).
ourses in Major	1 s.c.	EE 113—Introductory Systems Theory.
	1 s.c.	EE 143—Fields and Continua.
	4 s.c.	EE electives.
pproved Electives	1 s.c.	Must be an engineering science course taught within the School of Engineering.
pproved Electives	2 s.c.	Must be in engineering science, physical science, or mathematics.
pproved Electives	4 s.c.	
ther courses	15 s.c.	Listed under general requirements.

*One of the three courses in engineering and applied sciences as listed under general equirements must be EE 63.

Mechanical Engineering Departmental Requirements*

athematics	1 s.c.	Mathematics elective beyond Math 74.
atural Science	1 s.c.	Natural science elective (in addition to 3 s.c. listed under general requirements).
ocial Sciences and Humanities	1 s.c.	Social sciences-humanities elective (in addition to 4 s.c. listed under general requirements).
ourses in Major	1 s.c.	ME 101—Thermodynamics†
	1 s.c.	ME 123—Dynamics†
	1 s.c.	ME 136—Response of Systems†
	1 s.c.	ME 141—Mechanical Design†
	1 s.c.	ME 126—Fluid Mechanics†‡
	1 s.c.	ME 150—Heat and Mass Transfer†‡
	1 s.c.	ME 111—Physical Metallurgy†‡
	1 s.c.	Egr 122—Transport Phenomena†‡
mphasis Electives	4 s.c.	Advanced technical electives, chosen to emphasize a professional objective in the curriculum.
pproved Electives	4 s.c.	
ther Courses	15 s.c.	Listed under general requirements.

*The three courses in engineering and applied sciences listed under general requirements must be Egr 72, Egr 75, and Egr 83.

†A program of study in the Department of Mechanical Engineering must contain a inimum of nine subjects taught within the School of Engineering. The six particular ME ourses listed here and the three courses Egr 72, Egr 75, and Egr 83 listed under general equirements form the foundation of a normal mechanical engineering program.

‡Students specializing in materials science may substitute both ME 111 and Egr 122 or ME 126 and ME 150.

Double Major. If an engineering student satisfies the requirements of a epartmental major in the arts and sciences simultaneously with satisfying the requirements for a B.S.E. degree, or satisfies simultaneously the requirements f two engineering majors, his official record will indicate this fact, provided th the director of undergraduate studies for the second major certifies that its d partmental major requirements have been met and that the student initiates th procedure, either through the Dean of the School of Engineering or through th director of undergraduate studies in his department, and that the second depar mental major requirements be confirmed no later than the time of registratio for the final semester.

Courses which are common to both majors shall be counted toward sati fying the requirements of both majors.

Interdisciplinary Programs in Engineering. This major parallels the majo in biomedical, civil, electrical, and mechanical engineering. It provides for speci programs of study in interdisciplinary fields, such as energy conversion, enginee ing mechanics, materials science, ocean engineering, pollution control, syste and controls, and urban engineering, leading to the B.S.E. degree, which may b arranged with approval of the engineering faculty. Any student, in consultatio with his adviser or another faculty member, may propose a unique combinatio of courses designed to meet his particular career objectives. His proposal shoul be submitted to the Engineering Faculty Council, through the Dean of the Scho of Engineering, for approval; it may be submitted as early as the second semeste of the freshman year and must be submitted before the beginning of the seni year. The proposal should include the student's reasons for pursuing the suggeste program of study, and it must show how the proposed courses satisfy the follo ing requirements:

1. The proposed program of study meets the general requirements for th B.S.E. degree but cannot be accommodated by the approved departmental re quirements in biomedical, civil, electrical, or mechanical engineering.
2. A program of at least eight engineering courses is included to provid depth in the selected interdisciplinary area of study.
3. A program of at least five courses, in addition to the fifteen course listed under general requirements, is included to provide breadth in technic (engineering, natural science, and mathematics) areas.
4. The remaining courses, which are treated as electives, require the ap proval of the student's adviser.

Each student enrolled in an approved interdisciplinary program will be as signed to the appropriate engineering department for administrative pu poses.

Residence Requirements. At least sixteen semester-courses must be com pleted satisfactorily at Duke. This must include the work of the final two semester with the following exceptions: the student who has completed more than four fu semesters of work at Duke may take the last two courses elsewhere; others ma take one last course elsewhere. The courses taken elsewhere must be approved b the student's major adviser and his academic dean.

Continuation Requirements. A student must achieve a satisfactory recor of academic performance each semester to continue his enrollment in the Uni versity. His academic performance must be such that he will be able to complet his degree program in ten semesters with a normal course load.

A student must pass at least two courses in the first semester of the fresh man year and at least three courses in any subsequent semester. A student wh ils to meet this continuation requirement must leave the University for at least vo semesters. A complete summer session may be counted as a semester. Folwing a student's application for readmission, his return must be approved by the ean. If the student thereafter fails to pass three courses in a semester, he will be ermanently dismissed from the University. A student who fails two or more ourses in a given semester will not be permitted to enroll for more than four ourses in the following semester without the approval of the Dean. In addition, a udent may be dismissed temporarily or permanently for failing to make satisfacry progress toward graduation. In such circumstances, the student may be reuired to leave the University, either temporarily in order to remedy the conditions at explain his poor performance, or permanently when such action appears in e best interest of both the student and the University.

Grade Requirements for Graduation. Of the 32 semester-courses required r graduation, 28 or their equivalent in number must be passed with grades of — or better.

The School of Nursing

The baccalaureate program is designed to produce a professional nurse who:

1. comprehends and appreciates man's opportunities, responsibilities, and relationships in a dynamic environment,
2. develops knowledge, comprehension, and skills essential to the process of nursing,
3. develops knowledge and comprehension of a professional role within a social, biological, and cultural framework, and
4. develops a foundation for potential social sensitivity and the desire for continuous self-development and fulfillment.

The overall goal of the curriculum is to prepare graduates to assume effecvely responsibilities as professional nurses and liberally educated people. The ourse of study with its flexible approach prepares practitioners to begin to funcion as professionals in nursing services for individuals, families, and communities.

The curriculum provides a base for professional growth; the knowledg skills, and appreciations characteristic of the liberally educated individual; and foundation for graduate study. Studies in the freshman and sophomore years ar devoted primarily to the liberal arts and basic sciences; during these years, cocur ricular activities are provided to introduce the students to nursing. The focus the junior and senior years is the nursing major. Transfer students can be readil accommodated in a curriculum of this design.

The students are seen as aggressive, active participants in making decision about their own learning needs and interests. They are enabled and encourage to plan a program of study compatible with their background and interests whic will contribute to their personal and professional goals. With the guidance of academic advisers, students may elect courses and experiences which best serve the interests for concentration on an area of study or for exploration in several field Teaching techniques take into consideration the spontaneity, potential, and individuality of the student.

The distinctive features of the curriculum are:

1. Although every student acquires a base in the natural and soci sciences and humanities, students may choose to develop a second major i any of these three areas.
2. The conceptual framework of the curriculum is the nursing proces Students augment, complement, and integrate social, biological, and psychological theories and experiences as they use the nursing process in the ca of individuals in the need of health care.
3. Through courses comprising the professional nursing component, opportunities are provided for the student to progress in uniting knowledge an decision-making with nursing action concerning individuals, groups, an families whether they be hospitalized or in the community.
4. Nursing electives and independent study in the upper division perm students to pursue individual interests, to broaden their scope of nursing, an to gain a degree of proficiency in the type of initial professional practice i which they wish to engage after graduation.
5. The curriculum is theoretically oriented in the belief that studen who learn to select facts and theories from relevant disciplines for application to nursing practice will be able to adapt readily to changing modalitie of health care.

Program of Study. For graduation with a Bachelor of Science in Nursing legree a minimum of thirty-two semester courses plus two courses in physical eduation activity must be completed successfully. The courses are divided into ower and upper divisions with twelve upper division courses in nursing required or the nursing major.

Lower Division

atural Science	2 s.c.*	In sequence.† May select from chemistry, botany, zoology, physics, or geology.
uman Ecology I. II	2 s.c.	N97, N98
tatistics	1 s.c.	Any introductory course offered by Departments of Mathematics, Psychology, or Economics.
ocial Sciences	3 s.c.	One course must be in psychology and the other two may be: *a.* one in psychology and one in sociology or anthropology *b.* two in sociology *c.* two in anthropology *d.* one in sociology and one in anthropology.
Humanities	1 s.c.	No skill courses satisfy this requirement.
English Composition	1 s.c.	English 1 (see page 12).
Electives	6 or 7 s.c.	
Physical Activity	2 s.c.	No credit (see page 15).

*Semester-course(s).

†Exception is made to the "in sequence" requirement if the student takes Biology 14, which is only one course. In this case the student must select another botany or zoology course to complete the requirement.

Students must satisfy the small-group learning experience requirements, during the first two years, as outlined for students in the arts and sciences on page 13.

Upper Division

Theoretic and Scientific Bases for Nursing Practice	2 s.c.
Development of Nursing Skills and Attitudes	4 s.c.
Distributive and Episodic Nursing Practice	4 s.c.
Functional Aspects of Nursing Practice	1 s.c.
Required Independent Study	1 s.c.
Electives (include optional independent study)	4 s.c.

A student desiring to complete requirements for a second major in a depar ment of arts and sciences may do so and have both majors entered on his offici record. (See page 14.)

Continuation Requirements. A student must achieve a satisfactory recor of academic performance each semester and make satisfactory progress towar graduation to continue his enrollment in the School of Nursing. A student wh fails to meet the minimum requirements outlined below must leave the Universit for at least two semesters. A summer may be counted as a semester. Following student's application for readmission, his return must be approved by the Dea of the School of Nursing. If the student thereafter fails to meet continuation requirements, he will be permanently dismissed from the University.

Satisfactory Performance Each Semester. To remain in the School c Nursing, a student must not fail three or more courses in the first semester of th freshman year or fail two or more courses in any subsequent semester. An exception to this applies when a student fails a required nursing course worth tw courses.

Satisfactory Progress toward Graduation. A student must pass in th approved nursing curriculum at Duke the following number of semester-course (or their equivalent in half-courses or double-courses) to continue from on academic year to a subsequent year. (Summer terms *at Duke* may be used t meet this requirement.)

To begin enrollment in a	a student must have passed
second year	six semester-courses
third year	fourteen semester-courses
fourth year	twenty-two semester-courses
fifth year	twenty-eight semester-courses

Students are reminded that in cases where continuation is in question, incomplete work in any course is counted as a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grade to be submitted to the Registrar no later than the day preceding the opening o the spring semester or June 15 in the summer. In the case of incomplete work i the spring semester, this requirement applies whether or not the student plans t attend one or more terms of summer session.

Any student excluded from the School of Nursing under the provisions o this regulation may at his request have his case reviewed by the Undergraduat Studies Committee of the School of Nursing.

A minimum of fourteen courses must be passed before a student can proeed to the upper division professional curriculum. Twelve of these courses must ave been passed with a grade of *C*— or better. With the exception of transfer stuents, all lower division requirements must be met before entry to the upper ivision.

Requirements for Degree. To be graduated a student must pass a total of hirty-two courses (or an equivalent combination of courses, half-courses, and ouble-courses), including courses in the approved curriculum. Fourteen courses nust be passed at the advanced level. Of the thirty-two courses required for gradution, no more than two courses with *D* grades will be accepted. Only required and lective nursing courses with a grade of *C*— or better will be accepted toward raduation. It is required that for graduation the student have an overall *C* average r better in nursing courses.

Satisfactory completion of one year of physical activity is required for raduation unless a student is excused for medical reasons. This requirement can e met by satisfactory completion of one year in appropriate physical education ourses or by an alternate form of physical activity approved by the appropriate hysical education department. Pass/fail grades are assigned for performance in equired physical education courses and for alternate forms of physical activity. hysical education courses or alternate forms of physical activity do not count mong the thirty-two courses needed for graduation.

Residence Requirements. The requirements for the normal and maximum eriod of residence for students enrolled in the School of Nursing are the same s for those in Trinity College of Arts and Sciences (see page 15). However, the inimum time that any student may spend in residence (full-time study) at Duke efore receiving a Bachelor of Science in Nursing degree is one year unless the tudent is a registered nurse completing the requirements for a B.S.N. degree. or these students full-time and part-time study are possible.

Transportation Required. The use of facilities other than Duke and eterans Administration Hospitals requires transportation. It is the responsibility f each nursing student to provide transportation to and from the facilities seected for learning experiences in both the junior and senior years. While a few gencies may be within bicycling distance, most are not, and Durham's bus service s spaced at long intervals. Thus, a car or arrangements to share in a car pool ould be desirable.

Accreditation. In addition to the accreditation status accorded the niversity, the School of Nursing's undergraduate program is accredited by the ational League for Nursing and the North Carolina Board of Nursing.

3

Academic Procedures and Information

Advanced Placement

Demonstrated proficiency on certain tests or a record in previous educational experience are the criteria employed to determine a student's qualifications for certain advanced courses, with acceptable test scores being the basic criterion. Scores on the tests discussed below are used in granting placement in such courses.

CEEB Advanced Placement Program (APP) Examinations. Scores of 3, 4, or 5 on CEEB Advanced Placement Program Examinations are bases for placement in advanced courses in botany, chemistry, English,* French, German, history, Latin, mathematics, physics, Spanish, and zoology. A student presenting such a score and desiring to continue in the same subject matter at Duke may request an advanced course for the fall semester. (In selecting a course, see the section on major requirements of the appropriate department. Freshmen requesting advanced courses in the summer registration procedures will be notified of their placement in the late summer by mail or during Freshman Week.)

Any student who has earned a score of 3, 4, or 5 on a CEEB Advanced Placement Program Examination is approved for placement and may be considered for credit in the appropriate subject: botany, chemistry, English, French, German, history, Latin, mathematics, physics, Spanish, and zoology. For those students presenting scores of 3, credit will be determined, with the approval of the academic department concerned, no earlier than at the end of the first semester following completion by the student of a specified course in that department with a grade of *C* or better. Pass/fail grading is *not* an option for such courses. Ordinarily, the validating course must be taken by the end of the sophomore year. (Course credit may be granted for one or two semesters in each subject area in which an examination is offered in the Advanced Placement Program.)

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*The requirement in English composition, however, cannot be waived on the basis of these scores.

In the case of French, German, Latin, and Spanish, APP scores of 3. 4 or 5 may result in placement in courses at the 100-level; approval of the directo of undergraduate studies or supervisor of freshman instruction in the appropriate department is required before final placement is made. Advanced courses at the 100-level or above satisfy distributional requirements in the humanities.

CEEB Achievement Tests. Scores on CEEB Achievement Tests are the basic criteria for placement in French, German, Spanish, Latin, and mathematics. The following tables will assist students in making reasonable course selections in the subjects indicated.

French

CEEB Achievement Scores	*Course Placement*
200-396	French 1*
397-556	French 63
557 plus	French 91

German

CEEB Achievement Scores	*Course Placement*
200-365	German 1*
366-571	German 63
572 plus	Third year

Spanish

CEEB Achievement Scores	*Course Placement*
200-453	Spanish 1*
454-623	Spanish 63
624 plus	Spanish 91

Latin

CEEB Achievement Scores	*Course Placement*
200-529	Latin 1*
530-639	Latin 63
640 plus	Latin 91

Mathematics

CEEB Achievement Scores	*Course Placement*
500-800	Mathematics 31†
760-800	Mathematics 31X upo request of the student

*The first year of a language may *not* be taken for credit by a student who has co pleted more than two years of that language in secondary school. In rare cases, an exceptio may be granted with permission of the director of undergraduate studies in the appropriat department.

†A student with scores below 500 must obtain the permission of the Supervisor o Freshman Instruction to take Mathematics 31.

Students qualifying for courses in mathematics above Mathematics 3 will not be granted credit for courses bypassed unless they also present appropr ate scores on APP tests.

Waiver of English Composition Requirement. Students who preser a score of 700 or higher on the CEEB English Composition Achievement Tes are excused from the course in English composition required for graduation, *bu do not receive course credit for English 1.*

CEEB College Placement Tests. The CEEB College Placement Tests i French, German, Latin, and Spanish should be taken in Freshman Week by (1 those students who desire to continue in the language but have not taken th CEEB Achievement Test, and by (2) those students who, having taken th CEEB Achievement Test, wish to challenge the score obtained on that test f the purpose of qualifying for a higher level language course.

The CEEB College Placement Tests in French, German, Latin, and Spanis are administered at the end of each semester and at the close of the first term o the summer session for the convenience of those students who wish to demonstrat their foreign language proficiency by this means. Ordinarily students may tak this examination only twice while enrolled at Duke. Exceptions to this rule mus be approved by the student's academic dean. The taking of a CEEB College Place ent Test by students at the time of their matriculation at Duke, for the purpose f course placement, will not be counted as one of the two opportunities allowed.

All freshmen who plan to take mathematics at Duke during the fall semes- r, and who did not submit the CEEB SAT score or CEEB Achievement Test ore in mathematics, must take the CEEB College Placement Test in mathematics. tudents who have been denied placement in a mathematics course, or who have een placed in Mathematics 31, may take the CEEB College Placement Test to ualify for a higher course placement. Students who have been placed in Mathe- atics 31 and who wish a higher course placement need not take the CEEB ollege Placement Test but should contact the Director of Undergraduate Studies f the Mathematics Department.

Students who qualify for the third year of a foreign language on the basis f their score on a CEEB College Placement Test will not receive credit for ourses thus bypassed. Such students may wish to discuss with the appropriate irector of undergraduate studies the possibility of enrollment in a course at the 00-level. Literature courses on the 100-level satisfy distributional requirements the humanities division.

Placement in Russian. Students who wish to continue in Russian at Duke hould see the Director of Undergraduate Studies in that department. In the ase of Russian, neither CEEB Achievement Test scores nor CEEB College lacement Test scores have been sufficiently validated to serve as criteria for lacement. Therefore, the Russian department offers a departmental examination hich is used in conjunction with other criteria for placing students at the appro- riate course level.

Placement in Nursing. Registered nurses wishing to complete requirements or the Bachelor of Science in Nursing degree or students wishing to transfer ursing courses from other schools of nursing should see the Director of Under- raduate Studies of the School of Nursing. Examinations and other criteria are sed to assist these students in obtaining appropriate placement in the approved urriculum.

eading-Out of Introductory Courses

Students of demonstrated academic ability may be granted the option of reading-out" of an introductory or prerequisite course in order to allow them o advance at their own pace to upper-level work. No course credit may be arned by "reading-out." Any student interested in reading during the summer

to bypass an introductory or prerequisite course must be recommended by hi dean and secure the approval of the department concerned. Reading for a cours and auditing are mutually exclusive procedures. A proposed program of readin should be approved by the director of undergraduate studies in the departmen in which the work will be done. On passing a qualifying examination prepare by the department, a student may be certified for advanced course work in th area. On completion of an advanced course, an entry will be made on his permanent record that he has passed a qualifying examination but no course credit i awarded. Interested students should request further information from their respective dean's offices.

Registration

New students register by mail preceding matriculation for their first colleg semester. Preliminary registration materials are sent in May and November to al entering freshmen and in July and November to all transfer students. By becomin familiar with these materials the student can plan an academic program. To accomplish registration, course cards sent to each student are filled out and returne to the office of the appropriate school or college. It is understood, of course, tha entering students may change some course selections after they have receive counseling during orientation.

Continuing students are expected to register at specified times for each successive semester. Prior to registration each student receives special instruction and registration materials. He prepares a trial course program and presents i at an appointed time to his adviser or to a faculty member designated to assis him in reviewing it. This approved schedule is then presented at registration.

Students who contemplate teaching in elementary or secondary school should consult an appropriate member of the Department of Education prio to each registration period to ensure that they are meeting requirements for certification (many states have unique requirements) and they will have places reserve in the student teaching program.

Those who register at a time later than the day specified in the Universit calendar are subject to a $10.00 fine. Students who fail to register are automaticall withdrawn and must apply for readmission if they wish to return; they also forfei their $50.00 registration deposits unless they indicate at the time of registratio their intention not to continue in the University the following semester.

Semester Opening. Students are expected to report to a designated offic at the beginning of each semester to obtain a semester enrollment card. Any student who is unable to do this should notify his academic dean that he will b late in arriving. Failure to report, or to account beforehand for one's absence entails a loss of registration in courses. An official enrollment is required fo admission to any class.

During the first two weeks of classes, changes in the schedule for whic a student is registered can be made. Course changes initiated by the studen entail a fee of $1.00 per change.

Course Changes After Classes Begin. Except in the School of Nursing an the School of Engineering, students may drop and add courses during the firs week of classes at their own discretion. During the second week, they may dro courses at their own discretion, but the signature of the appropriate instructo will be required for adding courses. Students are reminded that it is their responability to be certain that their course load conforms with the academic requirements. Within the School of Nursing and the School of Engineering the signature f the adviser is necessary for dropping or adding courses after classes begin.

Students may drop a course without penalty until the time mid-semester rades are assigned if clearly carrying a course overload. Factors such as poor ealth or necessary outside work are also considered in permitting withdrawal rom courses without penalty. A *W* is entered on the permanent record in lieu f a grade in all cases where withdrawal without penalty is approved. After he time limit has expired, withdrawal from any course will ordinarily result in grade of *F*. Courses discontinued prior to mid-semester without approval will lso be assigned an *F*.

Course Load and Eligibility for Courses

The normal and expected course load each semester is four semester-courses. To take fewer than four or more than five semester-courses in any semester, a tudent must have the approval of his academic dean. No student, however, may ake more than six courses in any semester. Seniors who need fewer than eight ourses may take a three-course load either semester.

The rules established by the Graduate School provide that juniors and well-qualified sophomores may enroll in a 200-level course if they have earned an overall *B* average and have obtained the written consent of the instructor, as well as that of the director of graduate studies in the department concerned. Sophomores must have also the approval of the director of undergraduate studies.

Seniors who at the beginning of a semester lack no more than three semester-ourses for the fulfillment of the requirement for the A.B. or B.S. degree may nroll in graduate courses for a maximum total program of five semester courses. The permission of the Dean of the Graduate School is required.

Course Audit

With the written consent of the instructor, a full-time degree student is allowed to audit one or more courses in addition to the normal program. With he consent of the instructor and the Registrar, alumni may audit undergraduate courses at the usual auditing fee. After the first two weeks of classes in any semester, no student classified as an auditor in a particular course may take the course or credit, and no student taking a course for credit may change classification to an auditor. A student may not repeat for credit any course he has previously audited. Auditors submit no daily work, take no examinations, and receive no credit for courses.

Independent Study

Independent study enables a student to pursue individual research and reading in a field of special interest subject to the supervision of a member of the faculty. (See page 13.) A student—with approval of his adviser, the instructor, and the director of undergraduate studies of the instructor's department—may enroll in independent study for any semester of his enrollment at Duke.

House Courses

House Courses are initiated and organized by students within given residential units. They are generally, but not necessarily, interdisciplinary in nature.

Each course must be sponsored by a faculty member in the arts and science and must be approved by the department of that faculty member as well a by the Committee on Courses of the Undergraduate Faculty Council if student are to earn credit for the course. House Courses are numbered 179 or 180 (fal and spring, respectively) and carry half-course credit. House Courses do not fulfil distributional requirements. Grades are submitted on a pass-fail basis. Student are invited to speak with the Secretary of the Committee on Courses for furthe details.

Advanced Courses and Placement Programs

Ordinarily advanced courses, above the introductory level, are numbere 100 or above. An undergraduate in Trinity College of Arts and Sciences shoul not assume that courses to which he may be admitted as a result of the Colleg Board Advanced Placement Examinations (APP) or Duke placement examina tions necessarily qualify as "advanced courses" of the type required for gradua tion. (See page 14 for the requirement on Advanced Work.)

The CEEB Advanced Placement Program Examinations (APP) and th Duke placement tests are used to decide placement in various courses above the in troductory level. (See pages 35-36 for descriptions of the procedures leading t advanced placement on the basis of CEEB and Duke placement examinations.) Only the APP examinations may lead to semester-course credit toward graduatio for the course or courses omitted and to the fulfilling of *requirements*. (See pag 12, Proficiency in English Composition, for an exception.) The departmenta directors of undergraduate studies and the University Registrar are charged wit the responsibility for evaluations leading to placement in courses above th introductory level.

Course Credit

The unit of credit for academic work in the college or schools is th semester-course, which ordinarily consists of three to four hours of instructio time each week of the semester. Double-courses, half-courses, and a few quarter-courses are recognized. Credit for thirty-two semester-courses is required fo graduation.

Transfer Credit. Duke credit may be granted for course work satisfactoril completed at other regionally accredited, degree-granting institutions. Course in which grades of less than *C*— have been earned are not accepted for transfe credit. The semester-course credit unit awarded at Duke for satisfactorily completed courses cannot, of course, be directly equated with semester-hour or quarter-hour credits. A semester's work accepted as a normal course load by the othe institution transfers as a block of four course units at Duke, provided the course taken at the other institution are acceptable by Duke as Duke course equivalent or electives. Ordinarily, a transfer student will not be awarded more than fou course units for one semester's work unless he has satisfactorily completed more than the normal course load at the institution from which he transfers. All courses approved for transfer credit are listed on the student's permanent record at Duke but grades earned in such courses are not recorded.

Courses taken at other institutions are evaluated by the University Registrar. Credit for courses in science, mathematics, and foreign language taken at a junior college may also be evaluated by the Duke departments concerned, as are some courses that have no Duke equivalents.

Students who transfer to Duke may receive credit for a maximum of two years of work at other institutions of approved standing. No credit is given for work completed by correspondence, and credit for no more than two semester-courses is allowed for extension courses.

Declaration of Major or Division

At the end of the freshman year, each student is assigned to an academic dean on the basis of his major or division of developing interest. It is necessary, therefore, for each freshman to declare either (1) a departmental major, or interdepartmental concentration, *or* (2) the division (humanities, social sciences, or natural sciences) of his developing interest, no later than the April registration period. A freshman, however, may declare a major or interdepartmental concentration prior to the April registration period, in the office of his academic dean. A special card for declaring the major is provided in the registration packet, prepared for each student by the Office of the Registrar. The student's registration for the fall semester or summer term(s) will not be complete (i.e., his course requests will not be processed) unless the declaration is made. If a freshman declares a division rather than a major, he must declare a departmental major (or interdepartmental concentration) in the office of his academic dean before mid-February of his sophomore year.

A sophomore who has not declared a major by mid-February will not receive registration material for April.

When a student declares his major, a check sheet is prepared, in the office of the college recorders, showing the student's progress toward fulfilling degree requirements. The check sheet is sent to the department of the student's major for advising purposes prior to each registration period. Any student who declares an interdepartmental concentration does so only after he has conferred with the director of undergraduate studies in the two departments concerned. The student's program of proposed course work, listing at least three courses beyond the introductory level in each of two or more departments, must be approved in writing by the directors of the two or more departments and presented to the student's academic dean. The proposal should include a suggested title of the interdepartmental study as it should appear on the student's permanent record. With the approval of the departments concerned, the student indicates, on the declaration-of-major form, which department will take administrative responsibility for his academic advising.

When a student declares a major or an interdepartmental concentration in the office of his academic dean, he should be prepared to identify his second and third divisions. After declaring the major, the student consults a departmental adviser each semester during an announced period for registration.

Changes in departmental majors or interdepartmental concentrations must be registered in the office of the student's academic dean.

Declaration of a Second Major

A student may declare a second major to be recorded on his permanent record. A second major should be declared in the office of his academic dean before a student registers for his final semester.

Class Attendance and Excused Absences

Responsibility for class attendance rests with the individual student. He is expected to attend classes regularly and punctually and must accept the consequences of failure to attend. An instructor is privileged to refer to the dean of the appropriate college for suitable action students who in his opinion are causing their work or that of the class to suffer because of absences. When excessive absences result in a student's failure to carry a normal course load, the dean, after a conference with the student, will determine whether the student may continue his enrollment in the college.

Absences from required classes and tests ordinarily are excused only for illnesses certified by a proper medical official of the University, and for authorized representation of the University in out-of-town events. Officials in charge of groups representing the University in such events are required to submit names of students to be excused to the appropriate dean's office forty-eight hours before absences are to begin.

Final Examinations and Excused Absences

Customarily an examination is the final exercise in an undergraduate course, but it is understood that not all courses profit from this process. Therefore, unless departmental policy stipulates otherwise, the conduct of the final exercise is determined by the instructor, except that a final written examination may not exceed three hours in length and a final "take-home" examination may not require more than three hours in the actual writing. The times and places of final examinations are officially scheduled by the University Schedule Committee, generally according to the day and hour at which the course regularly meets. "Take-home"

examinations are due at the regularly scheduled time for an examination given at the time period of the class. No changes may be made in the schedule without the approval of the Committee.

Absences from final examinations are excused by the appropriate academic dean only in exceptional circumstances, such as illness certified by a medical official of the University or other conditions beyond the control of the student. A student who misses a final examination must notify his dean within forty-eight hours after the scheduled time of the examination. Failure to so notify and to present an acceptable reason for his absence from the examination will result in the student's receiving an *F* in the course.

Grading and Grade Requirements

Final grades on performance in academic work are sent to students and parents, or guardians, after the examinations at the end of the fall semester. At the close of the spring semester, grades are mailed to the student's home address. Mid-semester advisory grade reports for freshmen are issued each semester.

Passing Grades. Passing grades are *A*, exceptional; *B*, superior; *C*, satisfactory; and *D*, low pass. A passing grade may be modified by a plus or minus. A *Z* may be assigned for the satisfactory completion of the first semester of a two-course sequence. This permits an instructor to assign an earned grade for the entire year during the grading period for the second course of the sequence.

The D Grade. Although the *D* grade represents *low pass,* no more than two courses passed with *D* grades may be counted among the thirty-two courses required for graduation. Courses for which a *D* grade is earned, however, may satisfy distributional requirements.

Failing Grades. A grade of *F* or *U* (see pass/fail option below) indicates that the student has failed the course. This fact is recorded on the student's record. If he registers for the course again, a second entry of the course and the new grade earned is made on the record, but the first entry is not removed.

Pass/Fail Grading Option. With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each semester or summer session. In addition, with the consent of the instructor, adviser, and director of undergraduate studies, a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain internships and small-group experiences are offered only on a pass/fail basis. Unless a course is offered *only on a pass/fail* basis, a course passed under the pass/fail option does not apply to distributional requirements.

A student enrolling in a course on a pass/fail basis completes all the work of the course but receives either a pass *(P)* or fail *(U)* grade in lieu of a standard grade. After the first two weeks of classes in any semester, no student may change his status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

Grades When Absent from Final Examination. In all cases in which a student is absent from a final examination, he receives an *X* instead of a final grade. If he does not present an acceptable explanation for his absence to the appropriate academic dean's office within forty-eight hours after the scheduled time of the examination, the *X* is converted to an *F*. If the absence is excused by an academic dean, the student arranges with the dean and the instructor for a make-up examination. An *X*, not cleared by the end of the semester following the examination missed, is converted to an *F*. (See Final Examinations and Excused Absences on page 42.)

Grades for Incomplete Work. If because of illness or other emergency a student's work in a course is incomplete, he may receive an *I* for the course instead of a final grade. Incomplete courses must be completed before the close of the succeeding semester; otherwise, the *I* is converted to an *F*. Seniors are expected to complete all courses before graduation. In case a student whose work is incomplete is also absent from the final examination, he receives an *X* for the course.

For the purposes of determining if a student satisfies continuation requirements, an *I* is counted as failing to achieve satisfactory performance in that course.

Commencement

Degrees are awarded in May at commencement exercises to those who have completed requirements at the end of either regular semester of the academic year. Those who complete degree requirements at the end of a summer term become eligible to receive diplomas dated September 1, but no commencement exercises are held for such graduates, and the diplomas are mailed in December, after final approval by the University faculty and Trustees.

Eligibility for Academic Honors

To determine eligibility for academic honors, *only* letter grades earned at Duke, with the exception of the *P* (pass) grade, enter into the calculation of he average.

Dean's List. In recognition of academic achievement, freshmen, sophomores, and juniors who carry a normal academic load and earn a *B* average or igher in the two semesters of an academic year are placed on the Dean's List f the following additional requirements are met:

1. Six semester-courses must be presented in which grades other than *P* have been awarded.
2. No student receiving an incomplete or failing grade within the academic year shall be placed on the Dean's List.

Class Honors. Students in the freshman, sophomore, and junior year who carry a normal academic load and earn a *B*+ average on all work for the year are eligible for Class Honors provided the following conditions are also met:

1. Six semester-courses must be presented in which grades other than *P* have been awarded.
2. No student receiving an incomplete or failing grade within the academic year shall be eligible for Class Honors.

Graduation Honors. Full-time or part-time students who earn the following averages for all work taken at Duke are graduated with honors: a *B* average earns a degree *cum laude;* a *B*+ average earns a degree *magna cum laude,* and an average of *A*— or above earns a degree *summa cum laude.*

Graduation With Distinction. Independent study and other honors opportunities are available under the title *Graduation with Distinction* in the majority of the academic departments for students in Programs I and II. Departments or interdepartmental honors committees may invite students at the end of the sophomore or junior year to enter the Graduation with Distinction Program. To be eligible, students must show promise of achieving by the time of graduation at least a *B* average in the major field. After participation in a seminar in the junior or senior year, and/or a directed course of reading, laboratory research, or other independent study, the student must present the results of his individual research and study in a distinguished piece of writing. The student's achievement, including the paper, is assessed by a faculty committee. If the student has at least a *B* average in the major field, the committee may recommend that the student be graduated with distinction in his major field. Interested students should consult the director of undergraduate studies in his department.

In the case of a student engaged in an interdisciplinary program the student must attain an overall *B* average for his courses taken in the departmental areas of his concentration or special study; his achievement is assessed by an interdepartmental honors committee established by the directors of undergraduate studies in the departments concerned.

Enrollment for the Duke Summer Session

Undergraduates of Duke University who plan to attend one or more terms of a Duke summer session or who plan to take a course in independent study during the summer should register if possible at the same time they register in the spring for the fall semester. Instructions are included in the registration packe distributed to Duke students in early April at which time the *Bulletins of the Summer Session* also are available. Enrollment after the spring registration perio should be initiated in the office of the appropriate academic dean. Undergraduate in universities or colleges outside of Duke University should apply directly to th Director of the Summer Session, Duke University, Durham, North Carolina 27706

Distinctive features of summer session instruction are provided in th various conferences sponsored by several of the departments and by a program i marine biology offered at the Duke Marine Laboratory, Beaufort, North Carolina. See *Bulletin of the Summer Session.*

Changes in Status

Withdrawal and Readmission. A student who wishes to withdraw from college must give official notification to his academic dean. Withdrawals at studen initiative prior to the Thanksgiving recess in the fall semester or prior to Apri 15 in the spring semester are coded as voluntary, and a *W* is entered in lieu of grade for each course. Voluntary withdrawals after these dates are permitted onl in the event of emergencies beyond the control of the student.

Applications for readmission are made to the appropriate school or college. Each application is reviewed by officers of the school or college to which the student applies. A decision is made on the basis of several criteria including the applicant's academic record at Duke, his prospects of completing requirements for graduation, his citizenship record at Duke, evidence of his increasing maturity and discipline, the degree of success attendant upon his activities during the time away from Duke, and finally the applicant's relative standing among the group of students applying for readmission.

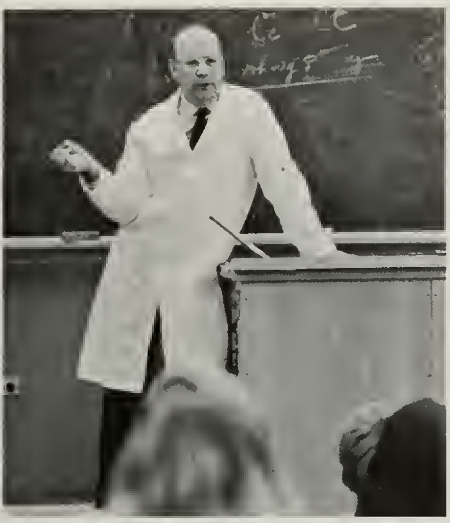
Applications for readmission must be completed by November 1 for enrollment in January, and by July 1 for enrollment in September. For readmission to the School of Nursing, however, it is required that the readmission procedure be completed by the student by March 1 for September enrollment and by November 1 for January enrollment.

Leave of Absence. An upperclass student in good standing may apply in writing to his dean to take a leave of absence for one or two semesters. He must apply before the end of the fall semester for a leave of absence during the spring semester, and before July 15 for a leave of absence during the fall semester. (See hand-out sheets in the office of an academic dean for further regulations and procedures concerning a leave of absence.) If the leave is approved, the student must keep his dean informed of any change of address.

Registration materials will be mailed to all students on leave of absence. A student failing to register will be withdrawn from the University and will have to apply for readmission.

A student who undertakes independent study under Duke supervision and for Duke credit is *not* on leave of absence even if he studies elsewhere. He registers at Duke as a non-resident student and he pays the appropriate fees or tuition at Duke. This also applies to Duke programs conducted away from the Durham campus.

Transfer Between Duke Schools and the College. A student in good standing may be considered for transfer from one Duke undergraduate school or college to another upon written application and request for letter of recommendation from his academic dean. The review of a student's request to transfer will involve con-



sideration of his general academic standing, citizenship record, and relative standing among the group of students applying for transfer. The school or college to which transfer is sought will give academic counseling to a student as soon as his intention to apply for transfer is known, although no commitment will be implied in doing so. A request to transfer should first be made to an academic dean in the college in which the student is presently enrolled. Subsequent procedural details will then be given. Students wishing to transfer to the School of Nursing for the succeeding year must complete transfer proceedings by April 1.

Full-Time and Part-Time Degree Status. Normally, undergraduate students who are candidates for degrees are expected to enroll for a normal course load each semester. A student who needs to change from full-time status, or from part-time to full-time status, must consult his academic dean. For special reasons approved by the dean, a full-time degree student who is qualified to continue may register in a part-time degree status for no more than two courses.

Resident and Non-Resident Status. Students other than freshmen who wish to live off-campus should receive authorization in the office of the Dean of Students, or from the Dean of Student Affairs of the School of Nursing, as appropriate.

If a resident student marries while enrolled and plans to move off-campus, a written request for a change to non-resident status must accompany the statement of marriage to the office of the Dean of Students. (In the School of Nursing, a letter from the parents/guardian to the Dean indicating knowledge of the forthcoming marriage must be received prior to the marriage.)

Students who become part-time or nondegree students cannot be accommodated in the residence halls.

Nondegree to Degree Status. A nondegree student must apply to the Office of Undergraduate Admissions for change in status to that of a degree candidate.

Study Elsewhere

Concurrent Enrollment. A student enrolled at Duke may not concurrently enroll in any other school or college without special permission of the appropriate academic dean. See, however, the statement regarding the reciprocal agreement with the University of North Carolina at Chapel Hill, North Carolina Central University at Durham, and North Carolina State at Raleigh.

Summer Schools—Other Colleges or Universities. Summer School approval forms for courses to be taken at institutions other than Duke may be obtained from the offices of the deans. A student wishing to transfer credit for summer work elsewhere at an accredited college should obtain approval of his course selections prior to taking the courses. He should present a summer catalog of the chosen institution to his dean and to the director of undergraduate studies in each discipline in which he proposes to take a summer course and request their approval.

Study Abroad. A Duke student may earn up to eight course credits during an academic year for approved work completed at a foreign university or for an approved program abroad sponsored by Duke or by another American college or university. To earn the equivalent of eight Duke course credits the student who studies abroad will be expected to take a full course load, as defined by the program or institution in which he is enrolled.

Duke, at present, offers several programs in cooperation with other universities. Grades earned in these programs are recorded on the student's official Duke record. Students accepted may study at:

Aix-en-Provence, France. Courses are given during both the fall and spring in French language, art, philosophy, and literature. Completion of French 64, or equivalent, is required prior to departure. This program is administered through Vanderbilt University.

Madrid, Spain. Work is given in Spanish language, literature, art, music, and history for either the fall or spring. Completion of Spanish 64, or equivalent, is required prior to departure. This program is under the direct administration of Vanderbilt University.

Rome, Italy. As one of the participating members in the Intercollegiate Center for Classical Studies in Rome, Duke University nominates majors in classical studies for admission to a semester's work at the Center, usually in the junior year. Instruction is offered in Greek, Latin, ancient history, ancient art, and archeology. Some scholarship help is available.

Munich and Freiburg, Germany. Admission to these programs entails matriculation at the University of Munich or Freiburg. The student must, therefore, meet their admission standards. Courses are taken in German language, literature, art, and history through Wayne State University, while additional courses are taken at the German universities.

Warwick, England. In the Warwick Exchange Program, selected Duke students spend a year of study at the University of Warwick, while students from Warwick study for the same period at Duke. The program is designed especially for majors in English, and it is administered jointly by Duke and the University of Warwick.

Duke University has sponsored summer programs abroad in Austria, France, Germany, Israel, Italy, and Spain. Students are selected competitively and have an opportunity to earn credit and grades for two courses.

Leaves of absence from the university are granted to students who study abroad. When possible, arrangements are made for them to register while abroad for the semester in which they plan to return. A student who wishes to transfer credit for study abroad should be guided by the following provisions established by the faculty and administered by the Committee on Study Abroad.

The student should:

1. have a scholastic average of at least a *B*—;
2. obtain provisional approval to study abroad from the academic dean in charge of study abroad and the director of undergraduate studies in his major department;
3. receive certification, when applicable, from the foreign language department concerned that he can handle adequately the language of the country where he will study;
4. obtain, *before* leaving Duke, approval for each course to be taken abroad, by the appropriate director of undergraduate studies, as well as approval of the program by the academic dean in charge of study abroad.

Usually work to be considered for transfer credit must be done in the language in which courses are normally given in the institution attended. Although no more than four semester-course credits can be transferred per semester for the satisfactory completion of a full-time program, all courses successfully completed by a student will be listed on his Duke record.

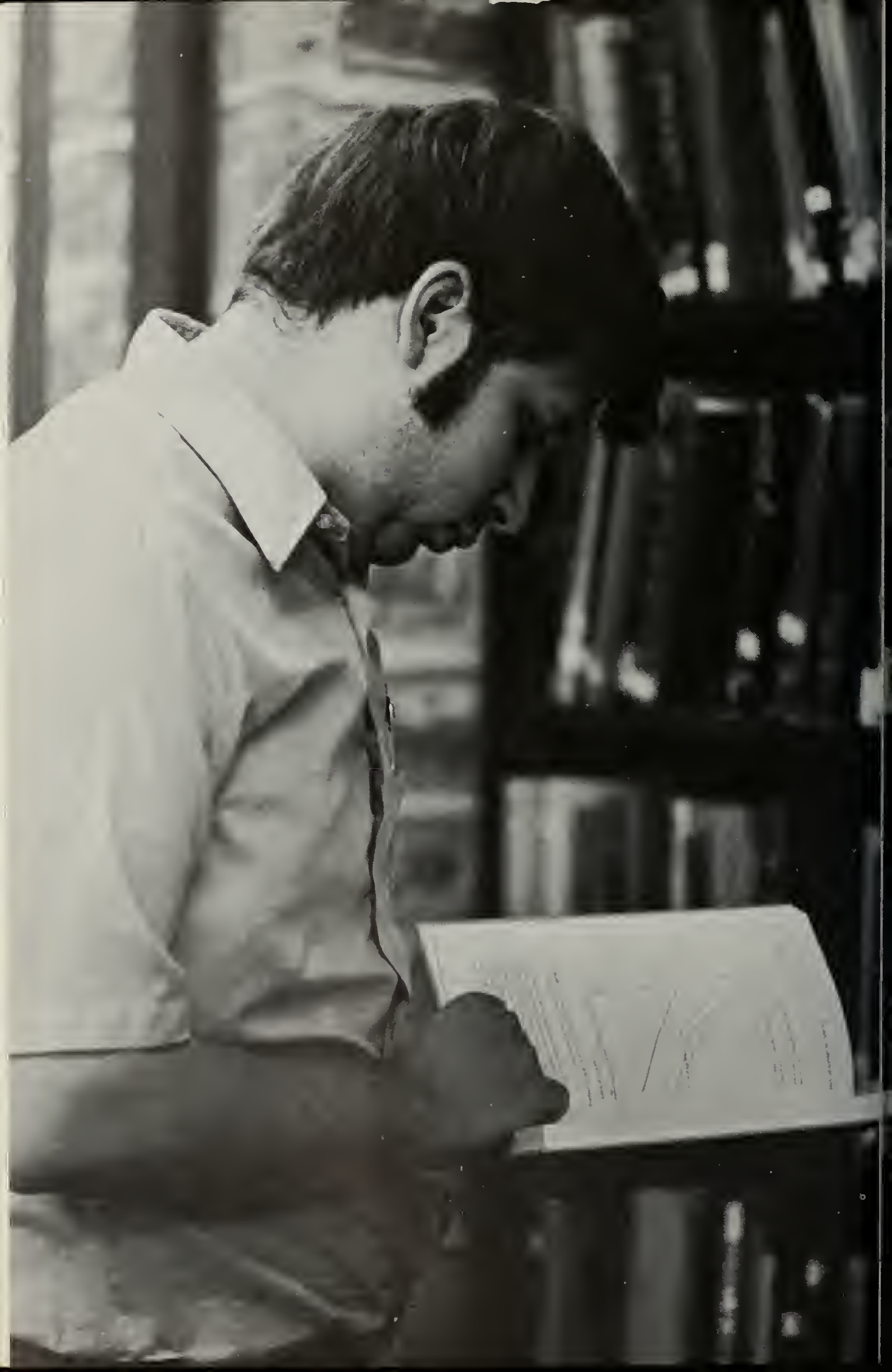
Information and counsel regarding study abroad may be obtained from the academic dean in charge of study abroad; in all cases he must be informed in advance about a student's plans if credit for the work is desired.

Other Information

Release of Student Records. No confidential information contained in student records (academic or otherwise) is released to non-University persons or to unauthorized persons on the campus without the consent of the student. Consent is evidenced by each student's signing a form which authorizes the release of personal data. The form may provide for the release of information to one or more persons or agencies only, or it may be a blanket release. Blank forms to authorize or revise the permission are available in the offices of the deans.

Identification Cards. Undergraduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privileges, university health services, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee.

The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of this card immediately to the Registrar's Office. The cost of a new ID card is $5.00.



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Cooperative Programs

Reciprocal Agreements with Neighboring Universities

Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and North Carolina Central University at Durham, a student regularly enrolled in Duke University, and paying full fees, may enroll for one approved course per semester at one of the institutions in the cooperative program. If the student takes two or more courses during a summer at Duke, one of the courses may be taken in one of the neighboring institutions under this plan.

Approval forms for courses to be taken at neighboring institutions may be obtained from the offices of the academic deans at Duke. Ordinarily, only those courses not offered at Duke will be approved. The student pays a normal registration fee of $2.00 plus any other special fees required of students at the host institution. All inter-institutional courses involving extra fees are taken at the expense of the student.

Continuing Education

By special arrangement, a limited number of nondegree undergraduate students are admitted by the Office of Undergraduate Admissions. These students are given academic and career counseling by the Director for Continuing Education. Nondegree students may register for most of the undergraduate courses open to degree students, but under no circumstances can places in courses be preempted for them. Nondegree students are subject to most of the regulations herein. See information concerning admission procedures on page 75 and financial information on page 79.

Residents in the Duke community who are beyond college age but who have interest in resuming or beginning an undergraduate education are invited to the Center for preliminary academic or career counseling. If admitted to a non-degree program in Continuing Education, such students are on review and may apply for degree status after the satisfactory completion of four courses.

Each semester a series of *short non-credit* courses for members in Duke community are sponsored by the Center for Career and Continuing Education. For further information consult the Director, Center for Career and Continuing Education.

Reserve Officers Training Corps

Through the Naval and Air Force Reserve Officers Training programs, the University is cooperating with the Department of Defense in providing well-educated officers for the regular and reserve forces of the nation.

The Naval Reserve Officers Training Corps. There are two basic programs through which students can qualify for Naval commissions upon graduation; one, the Scholarship Naval Reserve Officers' Training Corps Program, which provides a maximum of four years in the University largely at government expense, followed by a commission in the regular Navy or Marine Corps; the other, the Contract Program, which leads to a commission in the Naval Reserve or Marine Corps Reserve.

The Scholarship Program Student. Quotas are awarded on the basis of an annual nationwide test and selection procedure. Students selected are enlisted in the Naval Reserve, appointed Midshipmen, USNR, and receive four years tuition, fees, and textbooks at government expense. In addition they receive subsistence pay and summer active duty pay which amounts to approximately $1300 per year. The scholarship midshipman may take any major at Duke leading to a baccalaureate or higher degree. The student participates in two summer training cruises aboard ship and receives aviation and amphibious indoctrination at naval shore stations for one summer.

Upon graduation he receives a commission as Ensign in the Regular Navy, or Second Lieutenant in the Regular Marine Corps, after which he serves with the Navy or Marine Corps as required by the Secretary of the Navy in the same manner as his officer contemporaries who are graduates of the Naval Academy. The minimum period of active duty is four years for regular officers.

The College Program Student. The College Program student is selected from regularly enrolled freshman in Duke University who desire to qualify for a commission in the Naval or Marine Corps Reserve while pursuing normal courses of study. Upon graduation, normally he will be ordered to three years of active duty. He has the status of a civilian who has entered into a mutual contract with the Navy, and he is not eligible for the benefits and pay received by Scholarship Program midshipmen. He enlists in a component of the Naval Reserve and receives subsistence pay of $100 a month during his last two academic years. In addition he receives active duty pay (about $300) during the one required summer cruise, normally taken after his junior year.

Both Scholarship and College Program Students. No distinction is made between the two in the NROTC Unit. Contract Program students may compete each year for the Scholarship Program. If selected, they will be appointed to Scholarship status with the attendant benefits and pay. Both Scholarship and College Program students are deferred from Selective Service by virtue of their

commitment to serve on active duty after graduation; both are provided necessar uniforms, equipment, and Naval Science textbooks; both are furnished the sam instruction and those in both programs are required to wear uniforms on drill day and other special occasions prescribed by the professor of naval science. Upo completion of their undergraduate work, both may apply for continuing studie leading to a graduate degree. If he desires, a student in either program may elec the Marine Corps option at the beginning of his junior year, thus qualifying for commission in the Marine Corps. Both may participate in a Navy sponsore Flight Instruction Program leading to qualification for a private pilot's license, i successfully completed.

Academic Requirements for a Commission. The academic program fo an approved degree and a commission for Scholarship and College Progran students must include all Naval Science courses offered and the following:

For NROTC students majoring in engineering or mathematics, one yea of calculus, one year of physics or chemistry, and Mathematics 51 (or equivalent are to be completed by the end of the junior year. History 149, Managemen Sciences 125, and Political Science 121 are to be completed prior to graduation.

For NROTC students in other majors, one year of calculus (preferred), o one year of statistics and probability, one year of physics or chemistry (preferred) or one year of biological/earth sciences, and Mathematics 51 (or equivalent) ar to be completed by the end of the junior year. History 149, Management Science 125, and Political Science 121 are to be completed prior to graduation. Marin option students in their junior and senior years will take two relevant courses approved by the professor of naval science. These are taught by civilian facult members.

The Air Force Reserve Officers Training Corps (AFROTC). This uni functions as the Department of Aerospace Studies. It selects, trains, and commissions college men and women who desire to serve in the United States Air Force Two AFROTC programs exist, a four-year and a two-year program.

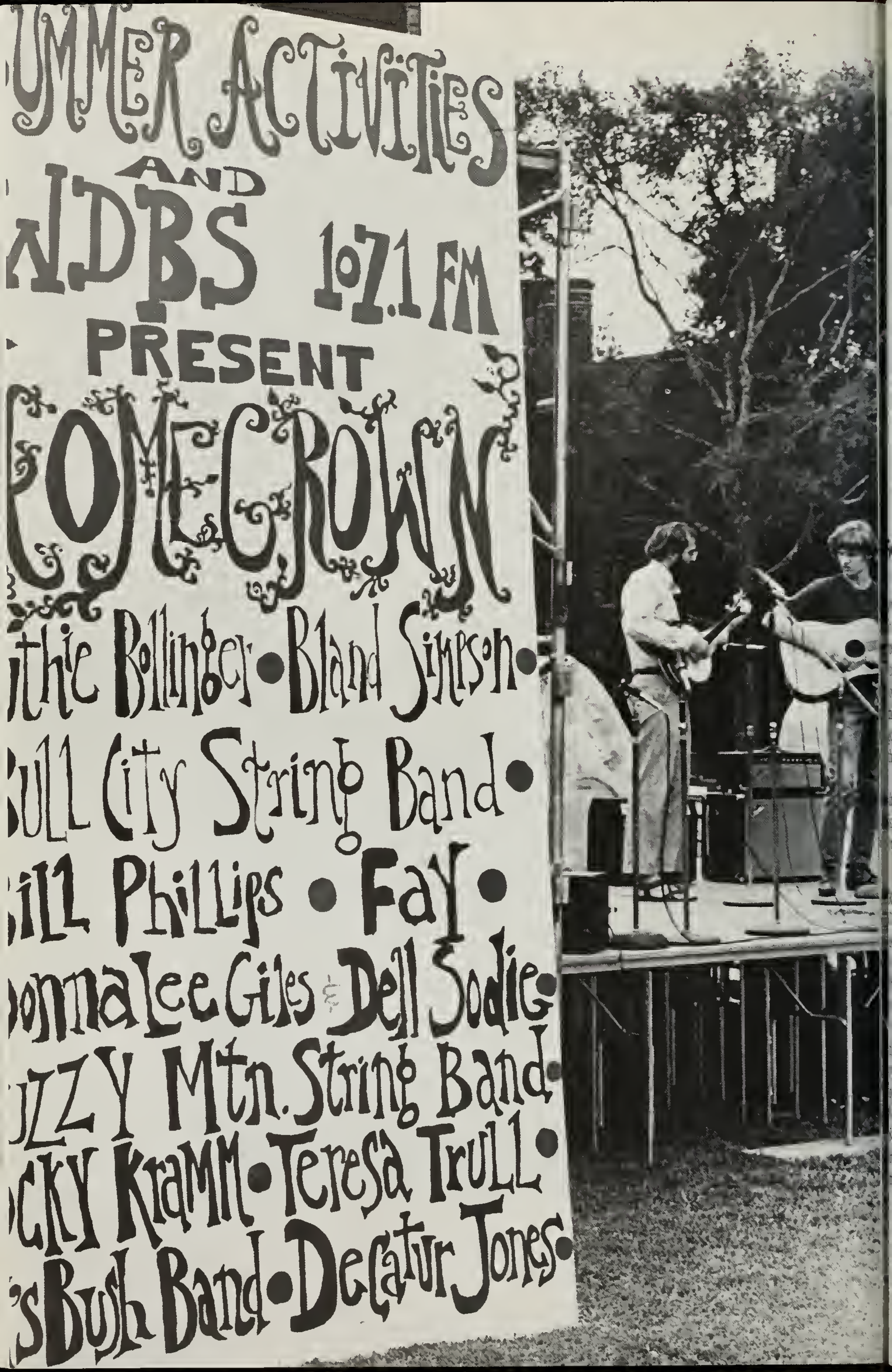
The four-year program consists of two segments, one covering the fresh- an and sophomore years which includes General Military courses, and the ther covering the junior and senior years which includes Professional Officer ourses. These two segments are linked by a four-week summer field training ncampment at selected Air Force bases. Entry into the four-year program is pen to freshmen and to sophomores who are willing to make up the course work issed due to late entry into the program. For sophomores this amounts to taking oth the freshmen and sophomore courses in one year.

Applications for the two-year program should be submitted no later than e spring semester of the sophomore year. Candidates attend a six-week field- aining encampment following their sophomore year, which concentrates on the ourse work missed during the freshman and sophomore years.

Cadets may compete for a scholarship if they so desire: freshmen for a ree-year scholarship to begin with the sophomore year; sophomores for a two- ear scholarship to begin with the junior year. Candidates for the two-year pro- ram may compete for a scholarship during the six-week summer encampment. cholarships cover full tuition, cost of all required books, certain fees, as well s a stipend of $100.00 per month. Regardless of whether or not a cadet receives scholarship, all cadets receive a tax free stipend of $100.00 per month (limited o $2000.00) during their junior and senior years.

A four-year active service plus two-year reserve commitment is incurred pon entry into the Professional Officer segment of the AFROTC Program. For etails on entry and commissioning requirements, contact the office of Aero- pace Studies.

Army and Navy Nurse Corps Student Program. Students in the School of ursing may apply for appointments in the Army Student Nurse Program at the eginning of their junior year, or in the Navy Nurse Corps Candidate Program at he beginning of their senior year. The appointments carry generous financial llowance. A student who participates twelve months or less serves on active uty in the respective service for twenty-four months. If support for two years as been given, thirty-six months of active duty are required.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Student Life

Residential Facilities

It is the aim of the University to provide through its residential program convenient and comfortable lodging that features opportunities for informal learning and the enrichment of the total educational experience. The living units, therefore, are organized to encourage for their residents an intellectual atmosphere, a stimulation of interest in cultural and co-curricular activities, and opportunities for interchange with faculty members and staff, as well as with students from many parts of the country. To assist in the implementation of responsible house government and activities, a member of the residential staff from the office of the Dean of Students lives in most of the houses.

Freshman students are required to live in University residences unless they live at home with parents or close relatives. Housing on campus, however, is not available to transfer students, to former students who have been readmitted, or to part-time students.

Residences for Undergraduate Women (Except for Nursing Students). Residential units for undergraduate women are located on both the East and West Campuses, the predominant number being on the East Campus. Upperclassmen as well as freshmen live in these houses in an approximate ratio of two to one. Because there are no sorority houses and no all-freshman houses for women these cross-sectional residences provide for a mix of students with a wide range of interests and maturity.

A limited number of spaces are available for freshmen in houses where men and women are assigned to separate wings or floors of the same house. Another option exists in living-learning houses or corridors where students who qualify by application are brought together because of special interests. These houses generally are filled by upperclassmen and are unavailable to freshmen. Several residential units are members of a federation. A federation is a cooperating group of residents in contiguous dormitories, usually including two units for men and two units for women.

Residences for Undergraduate Men. Undergraduate men in Trinity Colleg of Arts and Sciences and in the School of Engineering live in residences locate on both the East and West Campuses, the predominant number being on th West Campus. There are all-freshman houses, independent houses with upper classmen and freshmen, and fraternity sections in residential units. Men an women reside on alternate floors or wings of three independent houses. Several o the fraternity and independent houses are members of a federation.

The all-freshman houses, located in Kilgo, Crowell, and Wannamake Quadrangles, accommodate approximately one-half of the freshmen. Each of thes houses elects its own officers and council and organizes social, intramural, an other types of programs.

After the freshman year, all fraternity men who live on campus are required to live in fraternity sections. Men who do not affiliate with a social fraternity may choose from among the seventeen independent houses that include freshmen as well as upperclassmen. Each of these houses has its own officers an its own programs. These programs include discussions with faculty members seminars, film festivals, as well as social and athletic events.

Residences for Undergraduate Women in the School of Nursing. Nursin students live in Hanes House and Hanes Annex. Entering students may reques a double or a single room but returning students have first choice of rooms. Afte the initial assignment, students arrange for room selection and roommates throug the Office of the Dean of Student Affairs in Nursing.

Resident house counselors, who are on the staff of the Dean of Studen Affairs, live in the dormitories and are responsible, with the cooperation of th student government, for the administration of the residential units.

Living Off-Campus. Students above the freshman level who wish to live off-campus should apply for such authorization from the Dean of Students o Trinity College of Arts and Sciences or the Dean of Student Affairs of the School of Nursing, as appropriate. Once non-resident status is approved, there can be no guarantee of a space in the dormitories should the student desire to move back on campus. Students beyond the normal fourth year of the undergraduate program cannot be guaranteed space in the dormitories.

The East Campus. All students residing on the East Campus and freshmen n the Graduate Center are required to contract for their meals in the University Dining Halls on a semester basis. They have the option of a seven-day, twenty-one meals a week plan for $340.00 per semester, or a five-day (Mon.-Fri.) fifteen-meals plan for $290.00 per semester. There are no provisions for changing plans during the semester. On the East Campus there are two dining halls. Ordinarily he students who reside in Southgate and Gilbert-Addoms take their meals in Gilbert-Addoms, and those living in the other East Campus dormitories take their meals in the East Campus Union. Students who reside in the Graduate Center and are on the board contract basis take their meals in the dining room in that building. There are provisions, however, for students who have board contracts o take their meals in the Great Hall or the University Room on the West Campus. Due to the large numbers of students served by the dining halls, it is not possible o provide special diets.

The West Campus. The dining facilities on West Campus include two cafeterias with multiple-choice menus, the Oak Room which is a service dining hall where full meals and *á la carte* items are served, and a self-service snack bar, he Cambridge Inn, which is open throughout the day and evening. West Campus students may also take their meals in the Graduate Center Dining Halls by paying cash and in either of the dining halls on the East Campus.

Freshmen and sophomores in the School of Nursing are required to conract for their meals in the University Dining Halls on a semester basis. Their options are the same as those offered to students residing on the East Campus. The board privilege is available for upperclassmen, who are not required to contract for their meals, by making arrangements through the Dining Halls Office n the Graduate Center.

Religious Life

"Eruditio et Religio," the motto emblazoned on the seal of the Universit proclaims belief in the essential union of knowledge and religion in the educational process. The Duke Chapel stands at the center of the campus, an inspirin symbol of the place of religion in the full human life.

In the University Service of Worship on Sunday morning, two hundre students participate by singing in the choir; at least one hundred other student aid in special ways as ushers, collectors, and assistants in the communion service

Opportunities are provided through the Chapel and its related activitie to translate worship into effective Christian living. Denominational, interdenominational, and interfaith loyalties are emphasized. Some Protestant, Roman Catholi and Jewish students are organized in their respective groups, each has a denominational chaplain or adviser, and activities are sponsored by a United Campu Ministry.

The University Christian Council, composed of students and a few facult members, promotes the interdenominational religious life in its many facet The work of the Council and of the denominational programs is under the supervision of the Chaplain to the University, who is also Director of Religious Lif He, with an associate director of religious life and several denominational chaplains, coordinates the religious program of the campus. They offer personal guidance and spiritual counsel to all students in matters related to their faith.

Additional opportunities for the enrichment of the student's religious lif are offered in organ and carillon recitals, choral concerts, other special service held from time to time, and in the sermons of distinguished guest preachers fro many lands who are heard in the Duke Chapel.

Services Available

Offices in Each College and School. In Trinity College of Arts and Science in the School of Engineering, and in the School of Nursing, there are dean faculty members, and counselors who are readily available to discuss various concerns with students and to assist them in matters relating to courses, major careers, co-curricular activities, life styles, residential matters, etc. Often, a dea or counselor within the college or school, or an assigned faculty adviser, is abl to help facilitate or expedite an idea or a plan in the mind of a student, if n directly, by referral. Each college and school has its own academic deans and/ advisers. In Trinity College of Arts and Sciences, there are academic deans fo freshmen as well as academic deans for upperclassmen according to the student' declared major or academic division. In the School of Nursing, each student i assigned an academic adviser for the freshman and each succeeding year.

The School of Nursing has its own Dean of Student Affairs, whereas th Office of the Dean of Students appertains to students in both Trinity College o Arts and Sciences as well as the School of Engineering. The Office of Black Affair pertains to the needs of all black students at Duke.

University Health Service. One of the prerequisites for fully enjoying an gaining the most from the University experience is a sense of well-being. The ai of the University Health Service is to provide medical care and health advice t help the student enjoy his privilege of being a part of the University communit To serve this purpose, both the University Health Services Clinic and the University Infirmary are available for student health care needs.

The facilities of the University Health Services Clinic are available during oth regular and summer sessions to all currently enrolled full-time undergraduate tudents as well as to regularly enrolled students in the graduate and professional chools.

The main components of the Health Service include the University Health ervices Clinic located in the Marshall I. Pickens Rehabilitation Center and he University Infirmary on the East Campus. For treatment of most illnesses or njuries, students should first contact the University Health Clinic. The campus us makes regular runs to the Rehabilitation Center; however, if required, emerency transportation can be obtained from either the Duke Campus Police or the urham Ambulance Service. Residential staff personnel should be consulted whenver possible for assistance in obtaining emergency treatment. For a description f the specific services provided by the University Health Clinic and Infirmary, he *Bulletin of Information and Regulations* should be consulted.

The University Counseling Center. The University Counseling Center proides a counseling service designed to assist individuals in gaining a better undertanding of themselves and of the opportunities available to them and to aid them n developing more effective problem-solving skills. The professional counselors o not attempt to impose solutions on the individual. They provide information he individual needs to make judicious decisions and help him work out his own roblems in ways that will be satisfying to him. The following are some of the reas in which the counseling services offered by the center have been found to e helpful: choosing a career. planning educational programs leading to careers, dentifying and overcoming educational deficiencies, developing greater self-nderstanding, and developing more effective social relationships.

The Counseling Center has available a wide variety of tests which may be mployed in the counseling process. These tests provide measurements, among thers, of general ability, scholastic aptitude, special skills, achievement interests, nd levels of adjustment. In the process of counseling, the counselee may, with he help of the counselor, choose those tests that may provide information he needs o make decisions.

Counseling undertaken in the University Counseling Center is confidential etween the counselor and counselee. The center releases counseling reports only o those persons specifically designated in writing by the counselee.

Center for Career and Continuing Education. The Center for Career an Continuing Education provides undergraduate men and women with assistance i establishing career goals. The center is based on the premise that the Universit itself is not the only learning environment available to students. The goal of th center is to identify and coordinate all the learning environments available t students which can help them in furthering their career goals.

Working in cooperation with the University Counseling Center, the Offic of Placement Services, and the deans in the undergraduate college and th several professional schools, the center sponsors a variety of programs whic allow students to preview the situations they are likely to find themselves in afte graduation. These include the Internship Program, which arranges voluntee placement in community agencies; the Continuing Education Program, which use student teachers, tutors, and assistants in meeting community needs; dormitor group counseling sessions which assist men and women in reflecting on contemporary career trends, identifying their own abilities and interests, and explorin career options; freshman introductions, a series of seminars to explore non-traditional careers and new trends in established careers; speakers' bureau whic brings community people into the classroom for lectures and discussions.

The center works with both men and women. The contemporary positio of modern women is of particular concern to the center, and to that end th center works closely with student groups interested in women's programs an studies.

Office of Placement Services. The Office of Placement Services is the liaiso between the University community and potential employers in business, education and government. Its concern is to help all Duke students obtain employment consistent with their qualifications, interests, and desires. The office arranges initia interviews with representatives from business and industry, schools and colleges, government agencies, and graduate schools, and maintains an extensive fil of job openings.

Seniors interested in the Office of Placement Services should register earl in the year. Personal interviews with members of the staff are available to senior after they have registered.

Information about summer employment is available to all students. A extensive list of summer openings is maintained, and occasionally interviews fo these jobs are arranged on campus.

Student Activities

Associated Students of Duke University. The Associated Students of Duk University (ASDU), composed of representatives of each of the undergraduat living groups on campus and representatives of students living off campus, i responsible for the articulation of student thought and opinion on University-wid matters and for the shaping of student opinion toward constructive changes i the educational process and University environment.

The ASDU legislature is composed of representatives of each of the undergraduate living groups on campus. It acts in three ways. First, it fulfills the rol of student government, chartering student organizations, regulating student elections, and certain aspects regarding conduct and so forth. Second, it attempts, as student voice, to discern problems of primary concern to the student body and t take positive action in those areas. Third, it tries to identify the more subtle aspect of decision-making which underlie these problems and focuses student attentio on these issues.

The executive cabinet is the coordinating body of all ASDU functions. It consists of the president, four vice-presidents (two from Trinity College of Arts and Sciences and one each from the School of Engineering and the School of Nursing), an executive secretary, and an administrative secretary.

Various executive committees of ASDU undertake projects for the direct benefit of the student body, such as those concerned with residential life, academic affairs, admissions, and so on. A budget commission allocates all student fees and university subsidies to the various student organizations.

Judicial System. Students in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing constitute an undergraduate community whose members are subject to the Undergraduate Community Code. Violations of the code and certain University regulations are adjudicated before the Undergraduate Judicial Board, composed of representatives of the student body, the faculty, and the administration. The constitution of the Board, the Judicial Code of the Undergraduate Community, and the procedural safeguards and rights of appeal guaranteed to students are published in the *Bulletin of Information and Regulations* for the undergraduate college and schools.

As provided under the judicial structure of the University, each residential unit has a Judicial Board which has jurisdiction over all offenses involving violations of regulations relating to dormitory procedures and social regulations not covered by the Undergraduate Community Code or University policies and regulations.

Regulations. Duke University expects and requires of all its students full cooperation in developing and maintaining high standards of scholarship and conduct. Each student is subject to the rules and regulations of the University as currently in effect or, from time to time, put into effect by the appropriate authorities of the University. At the same time, the individual is responsible for decisions and choices within the framework of the regulations of the community as Duke does not assume *in loco parentis* relationships.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension or expulsion, for failure to abide by the regulations or for other conduct adjudged unsatisfactory or detrimental to the University.

Responsibility for prescribing and enforcing rules and regulations governing student conduct rests ultimately with the Board of Trustees of Duk University and, by delegation, with administrative officers of the University an of the schools and college. In the undergraduate units, as well as in the Universit as a whole, many of these rules have been established over the years by cooperative action between students and administrative officers and, in the case of som rules, with participation of faculty members as well. Representative student organizations, such as student governments and judicial boards, and more recently community-wide bodies of students, faculty, and administrators, have initiate proposals for policies and rules necessary to assure satisfactory standards i academic and nonacademic conduct; and these proposals have been accepte by University officers and have become a substantial, if not all-inclusive, bod of rules governing student life at Duke.

The Judicial Board of the Student Government Association of the Schoo of Nursing (NSGA) has the major role in supervising phases of community livin which directly concern the welfare of the students in the School of Nursing.

For current regulations, the *Bulletin of Information and Regulations* shoul be consulted.

Office of Student Activities. The office of Student Activities has as it responsibility the coordination and advising of those activities, undergraduate and graduate, that transcend the individual college and schools with a major emphasi on the development of the full range of these activities as they relate to the educational function of the University. In addition, this office is responsible for giving financial advice and coordination in cooperation with the Controller's office.

Social and Cultural Organizations

The scope of the more than one hundred student organizations is suggeste by a partial listing of the following activities: Association of African Students Alpha Phi Omega service fraternity, Bridge Club, Chess Club, Campus Crusade for Christ, Cheerleaders, International Club, Karate Club, Outing Club, Sailing Club, Students for a Democratic Society, Women's Liberation, Young American for Freedom, and the YM-YWCA.

Seventeen national and two local social fraternities, as well as nine socia sororities, are represented on campus and governed by Interfraternity and Pan-Hellenic Councils.

Many opportunities are provided on campus in the area of music and drama. The Duke Chorale, the Chapel Choir and Chancel Singers, Marching Band, Pep Band, Symphony Orchestra, and the Madrigal Singers are examples of musical activities. Duke Players performs established and experimental drama; Hoof 'n' Horn presents musical comedy.

Most academic departments sponsor organizations and programs for students with special academic or professional interests. There are also academic and leadership honorary societies.

The Union Building, located on the West Campus, is the center for student activities. It houses, among other groups, the University Union which brings students together in carrying out its stated purpose—to stimulate, promote, and develop the social, recreational, cultural, educational, and spiritual activities of the Duke University community. The Union sponsors a broad program including lectures, concerts, recreational activities, dances, and exhibits adapted to the leisure time interests and needs of individuals and diverse groups within the University and Durham communities.

In one section of the West Campus Union are housed dining facilities, University store, grill, beer hall, soda fountain, post office, barber shop, bank, and ballroom. Elsewhere in the building are student organization offices, meeting rooms, an information center, music and reading lounge, and recreational areas. Additional services and activity areas are provided on the East Campus.

Office of Cultural Affairs. The Office of Cultural Affairs is located in the Union Building. It is responsible for the coordination of many of the cultural and entertainment events which take place on the campus. In addition, the Duke University weekly calendar of events and semester calendar of events are published and distributed from this office.

Publications by Students

The Duke *Chronicle*, the campus newspaper, is published five times weekly, and the student-operated FM and carrier current radio station, WDBS, produces daily programs. Three magazines and a comprehensive yearbook are published by and for all students. These publications are under the direction of a Publications Board empowered to choose the editors and business managers and to review and approve the financial statements of all franchised publications.

The *DukEngineer* is the official student-published magazine of the School of Engineering. It appears twice each semester and contains articles on technical and semi-technical topics and other matters of interest to the School.

The Charge is the student undergraduate handbook of the School of Nursing which is published by students annually. It contains information and regulations which pertain to students within the School of Nursing.

Recreational Activities and Intramurals

The Duke Recreation and Intramural programs provide all students an opportunity to participate in some form of informal and competitive physical activity.

The men's program consists of seventeen different activities which include archery, bowling, cross country, golf, handball, horseshoes, tennis, flag football, badminton, paddle ball, basketball, swimming, table tennis, volleyball, wrestling, softball, and track. In a typical year more than 3,000 students compete for the many intramural titles and trophies that are awarded. Each year Duke, North Carolina, North Carolina State, and Wake Forest meet in the annual Big Four Intramural Day.

The women's program encompasses competition in badminton, basketball, bowling, tennis, and volleyball. In addition, special events in other areas of interest are conducted, and various clubs including modern dance, water ballet, and other sports offer the student opportunities to take part in extracurricular activities.

Through coed intramurals, the student is encouraged to participate on a less competitive level promoting relaxed social interaction as well as physical activity. Opportunities for coed competition are provided in the areas of badminton, table tennis, tennis, and volleyball.

The University's varied athletic and recreational facilities are available for use by the students, and athletic equipment may be checked out by the students. Facilities for recreation include a golf course, lighted tennis courts, three swimming pools, a student activities building, three gymnasia, outdoor handball and basketball courts, an all-weather track, and numerous playing fields and informal recreational areas. A variety of clubs dealing with gymnastics, scuba diving, sailing cycling, karate, rugby, soccer, and other activities are available to intereste students.

Intercollegiate Athletics Program

The intercollegiate program for men at Duke University offers twelv varsity sports. They are football, cross country, soccer, basketball, swimmin fencing, wrestling, track, baseball, golf, tennis, and lacrosse. Freshmen are eligibl to participate on all varsity teams. Freshman and junior varsity programs ar provided in football and basketball.

Duke is a member of the National Collegiate Athletic Association and th Atlantic Coast Conference (ACC). The Atlantic Coast Conference consists o Clemson, Duke, Maryland, North Carolina, North Carolina State, Virginia, an Wake Forest.

The director of men's athletics provides departmental leadership and co ordinates all athletic policies with the University Athletic Council. The Counci consists of representatives from the undergraduate student body, the faculty the administrative staff, and the alumni. They meet with the Director of Athletic periodically during the school year to discuss the athletic programs and mak recommendations concerning athletic policies. The Chairman of the Council i appointed by the President of the University, and he is the official Universit representative at national and conference athletic meetings.

The women's athletic program, a function of the Women's Physical Education Department, provides intercollegiate competition in seven sports: basketball fencing, gymnastics, hockey, swimming, tennis, and volleyball. The teams ar coached and/or advised by members of the Women's Department or other appropriately trained personnel. One member of the staff serves as Athletic Coordinator.

Duke is a member of the National Association of Intercollegiate Athletic for Women and follows its philosophy and policies.

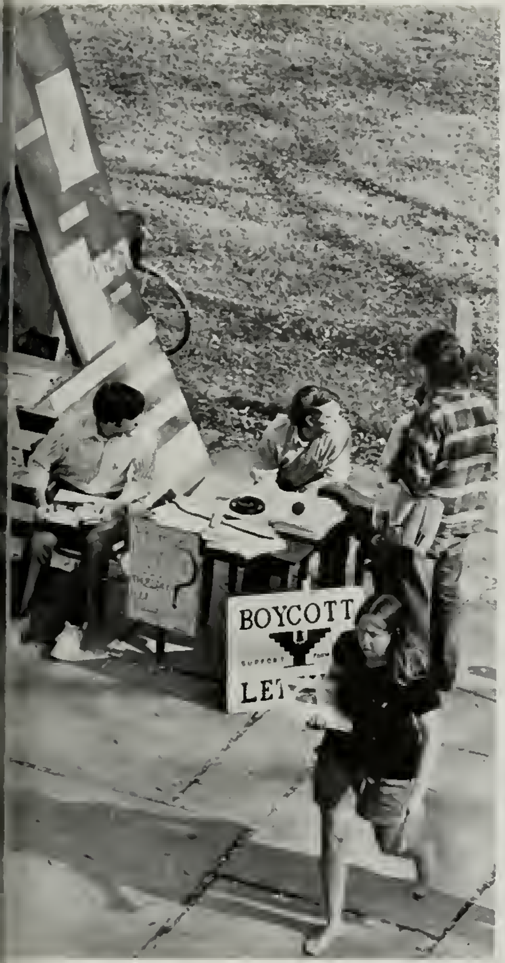
Prizes and Awards

The achievements of undergraduate students are recognized in various fields of college activity. The following prizes suggest the range of the recognition.

The Robert E. Lee Prize. This prize is the gift of the late Reverend A. W. Plyler, of the Class of 1892, and Mrs. Plyler. The sum of $50 is awarded annually at Commencement to the man in the senior class of Trinity College of Arts and Sciences or the School of Engineering who, in character and conduct, scholarship, athletic achievement, and a capacity for leadership, has most nearly realized the standards of the ideal student.

Julia Dale Prize in Mathematics. This is an annual cash prize of at least $50. The winner is selected by the Department of Mathematics on the basis of excellence in mathematics. In some years first and second prizes are given.

The Henry Schuman Music Prize. This prize of $100 is awarded annually to an undergraduate of Duke University for an original composition of chamber music or a distinguished paper in music history or analysis. The award is sponsored by Trinity College of Arts and Sciences and the Department of Music of Duke University through a continuing gift from Dr. and Mrs. James H. Semans who named the prize after Mr. Henry Schuman, a life-long friend of the Semans and Trent families, a talented amateur violinist, and one who helped to build valued collections in the Duke Library.



The Phi Lambda Upsilon Prize. Phi Lambda Upsilon, honorary chemical society, yearly awards a suitable prize to an outstanding junior who is majoring in chemistry. The recipient's name is inscribed on a plaque displayed in the Chemistry Library.

The Chemistry Department Award. This prize is awarded in the spring of each year for scholarship in chemistry, physics, and mathematics. The prize consists of a one-year junior membership in the American Chemical Society and a one-year subscription to either the *Journal of the American Chemical Society* or *Industrial and Engineering Chemistry.* To be eligible for this prize, the student must (1) be enrolled as an undergraduate of Duke University and (2) be taking or have taken a fourth-year chemistry course. The selection is based on the grade average for all courses taken in chemistry, physics, and mathematics. In case of a tie equal awards are given.

The James B. Rast Memorial Award in Comparative Anatomy. This award is given annually by the parents of James Brailsford Rast in memory of their son, a member of the class of 1958 at Duke University. The award, consisting of the *Atlas of Descriptive Human Anatomy* by Sobotta and bearing the

James B. Rast Memorial bookplate, is given to the student who demonstrates th greatest achievement in the study of comparative anatomy.

The Winfred Quinton Holton Prize in Primary Education. This prize wa established in 1922 by gifts of Holland Holton, '07, and Mrs. Lela Young Holton '07, in memory of their son, Winfred Quinton Holton, with the income to be use to provide a prize for investigative work in primary education. This prize of approximately $175 may be made annually. Competition is open to Duke senior and graduate students who are candidates for a degree in elementary education A student who wishes to be considered for the prize must submit a paper to b judged by a faculty committee in the Department of Education. The student mus first secure a faculty supervisor, and only scholarly papers which the student an faculty supervisor deem appropriate for publication should be submitted. Paper must be submitted by April 1 for consideration in a particular year.

The Anne Flexner Memorial Award in Creative Writing. This award ha been established by the family and friends of Anne Flexner, who graduated from Duke in 1945. It consists of $150.00 (first prize), $100.00 (second prize), and $50.00 (third prize). The awards are given annually for the best pieces o creative writing submitted by Duke undergraduates. The competition is limite to short stories (7500-word limit), one-act plays (7500-word limit), poems, (200 line limit), and informational essays (5000-word limit). Only one manuscript may be submitted by a candidate, and it must be delivered to the English Office, Room 325 Allen Building, by March 15.

The William Senhauser Prize. This prize is given by the mother of William Senhauser in memory of her son, a member of the Class of 1942, who lost hi life in the Pacific Theatre of War on August 4, 1944. The award is made annually to the student in Trinity College of Arts and Sciences or the School of Engineering who has made the greatest contribution through participation and leadership in intramural sports. The winner of this prize is chosen by a committee appointed by the President of the University.

The Roger Alan Opel Memorial Scholarship. A grant of $500 or mor is awarded annually to a Duke student who will spend an undergraduate year of academic study at the University of Exeter, England. The student is selected on the basis of intellectual curiosity, academic ability, and financial need. The award was established by the parents of Roger Alan Opel, a senior at Duke University who was killed in November, 1971.

The Friends of Duke University Library Prizes. This group offers three prizes in an annual contest open to all undergraduate students for the best book collections acquired during their college years. The contest is supervised by th Undergraduate Committee of the Friends of the Library, which announces each fall the terms of the award. Inquiries may be directed to the Curator of Rare Books. Collections entered in the contest are exhibited each spring in the Perkins Library. Th prizes are awarded on the basis of the student's collection, a personal interview t determine the overall planning and objectives of his collecting activity, and hi familiarity with his own books and the general field of his collecting interest.

The William T. Laprade Prize in History. This prize is offered in honor o William T. Laprade, who was a member of the Department of History at Trinity College and Duke University from 1909 to 1953, and Chairman of the Department from 1938 to 1952. It is awarded to that senior who is graduating with distinction and whose senior essay in history has been judged unusually meritorious.

Alpha

The Edward C. Horn Memorial Prize for Excellence in Zoology. This prize is given each year to the graduating zoology major who, in the opinion of the zoology faculty, shows the highest level of academic achievement and promise. It is offered in memory of Professor Edward C. Horn as a tribute to his warm regard for students and faculty and his appreciation of scholarly excellence. The prize consists of books appropriate to the student's field of interest.

The James A. Oliver Memorial Award. This award was established in 1963 by the family of James A. Oliver with the cooperation of Delta Mu Tau, Duke student music honorary fraternity, and is given to the student or students who have done the most to further the interest of music at Duke University. A prize of up to $350.00 is awarded annually.

The Tau Beta Pi Prize. This prize is awarded each year by North Carolina Gamma Chapter of Tau Beta Pi, engineering national honor society, to a sophomore student in engineering for outstanding scholastic achievement during the freshman year.

The Walter J. Seeley Scholastic Award. This award is presented annually by the Engineers' Student Government to that member of the graduating class of the School who has achieved the highest scholastic average in all subjects, and who has shown diligence in pursuit of an engineering education. The award was initiated to honor the spirit of academic excellence and professional diligence demonstrated by Dean Emeritus Walter J. Seeley. It is hoped that this award will serve as a symbol of the man and the ideals for which he stands. The name of the recipient is inscribed on a plaque displayed in the Engineering Building.

The American Society of Civil Engineers Prize. This prize is awarded annually by the North Carolina Chapter of the American Society of Civil Engineers to two outstanding seniors in civil engineering, upon recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record, his contribution to the student chapter, and his participation in other college activities and organizations. The prize consists of a Certificate of Award and the payment of one year's dues in the American Society of Civil Engineers.

The American Public Works Association Prize. This prize is awarded annually by the North Carolina section to an outstanding senior in civil engineering upon the recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record and his interest in a career in public works. The prize consists of a Certificate of Award, one year's payment of dues in the American Public Works Association, and a $25 cash award.

The George Sherrerd III Memorial Award in Electrical Engineering. This award is presented annually to that senior student in electrical engineering who, in the opinion of the electrical engineering faculty, has attained the highest level of scholastic achievement in all subjects and simultaneously has rendered significant service to the School of Engineering and the University at large. The award was established in 1958 by the parents of George Sherrerd III, a graduate of the Class of 1955, to recognize outstanding undergraduate scholarship. The recipient receives a monetary award and his name is inscribed on a plaque displayed in the Engineering Building.

The Charles Ernest Seager Memorial Award. This award recognizes outstanding achievement in the annual Student Prize Paper Contest of the Duke branch of the Institute of Electrical and Electronics Engineers. The award, established in 1958 by the widow and friends of Charles Ernest Seager, a graduate of the Class of 1955, consists of inscribing the name of the contest winner on a plaque displayed in the Engineering Building.

The Milmow Prize. This prize is awarded annually to the student from North or South Carolina graduating in the Department of Electrical Engineering who, in the opinion of the faculty of that department and, as shown by his grades, has made the most progress in electrical engineering during his last year in school. The prize consists of a Certificate of Award and one year's payment of dues in the Institute of Electrical and Electronics Engineers for the membership year in which the honoree is awarded his baccalaureate degree.

The American Society of Mechanical Engineers Award. This award is presented annually to a senior in mechanical engineering for his outstanding efforts and accomplishments in behalf of the American Society of Mechanical Engineers Student Section at Duke. The award consists of a Certificate of Recognition.

The T. C. Heyward Award. This award is given annually to the outstanding sophomore in mechanical engineering by Pi Tau Sigma. The award will normally consist of a handbook as well as a small cash award.

Duke University School of Nursing Alumnae Award. The Duke University School of Nursing Alumnae Award is presented to the student in the graduating class who has demonstrated outstanding leadership, scholarship, and nursing skill.

The Moseley Award. The Moseley Award of $25.00 is given to the student in the senior class who has shown the most skill in the art of nursing throughout her program in the School of Nursing.

Outstanding Service Award. The Outstanding Service Award is presented to the student who has demonstrated outstanding service to the School of Nursing or community by having consistently shared knowledge and ability either as a member of a group or a leader of a group for the educational or cultural improvement and welfare of others.

6

Admission

Principles of Selection

James B. Duke, in establishing his Indenture of Trust, requested that "great care and discrimination be exercised in admitting as students only those whose previous record shows a character, determination, and application evincing a wholesome and real ambition for life." In this light and in view of the institution's limited enrollment, Duke University looks beyond the basic characteristics of academic competence possessed by the majority of applicants. It seeks in each prospective student, regardless of race, sex, color, religion, or national origin, evidence not only of intellectual promise and maturity of judgment, but also a degree of positive energy. Often, this energy is expressed in the form of special talents and accomplishments, but it is consistently seen in a student's determination to make creative use of the opportunities and challenges posed by Duke University.

Requirements for Application

There are no inflexible subject matter requirements. At least 15 units of acceptable secondary school credit must be presented, however, and of these at least 12 must be in college preparatory subjects: English, foreign language, history and social studies, mathematics, and physical or biological sciences. Applicants for the School of Engineering are advised to present 4 units of mathematics and at least 1 unit in physics or chemistry.

The Scholastic Aptitude Test given by the College Entrance Examination Board and three Achievement Tests (one of which must be in English composition) are required of all candidates for admission. (Since placement in language study can be determined by an achievement test score, it is recommended that a candidate who expects to continue study in a foreign language take the CEEB Achievement Test in that language.) Candidates for the School of Engineering are required to take an Achievement Test in mathematics.

Application Procedures

Application forms and instructions may be obtained from the Office o Undergraduate Admissions, Duke University, Durham, North Carolina 27706. A non-refundable processing fee of $20.00 must accompany the completed application form. Candidates for admission to the freshman class must submit the results of the Scholastic Aptitude Test and three Achievement Tests, including English Composition, of the College Entrance Examination Board before their applications may be considered complete.

A personal interview at Duke is not required for admission; however, candidates are welcome to visit the campus and talk with a member of the staff of the Office of Undergraduate Admissions. A candidate who wishes an interview may write to the Director of Undergraduate Admissions for an appointment. Interviews cannot be guaranteed during the early months of the calendar year when applications are under review.

April Notification. Candidates for admission to the freshman class must apply no later than February 1 of their senior year in secondary school, and normally do so during the preceding fall. Decisions are mailed from the University by April 15, and accepted candidates are expected to reserve a place in the class by May 1.

February Notification. The student who indicates on his application that he wishes to learn his admission decision by February 15 of his senior year may observe a January 1 application deadline. The January deadline enables him to submit for review both his record for the first semester of the senior year and the

scores of the CEEB SAT and achievement tests taken through December. Applicants for February notification are free to apply concurrently to other colleges. Those who are accepted in February by Duke must reserve a place by March 1 and pay the registration and room deposit fees. The student considering the advantages of February notification would be wise to keep the March 1 reply obligation clearly in mind as he investigates the application deadlines of other colleges.

Midyear Admission. Midyear admission allows a limited number of freshmen to begin their college work a semester early or to postpone matriculation for experience in employment, travel, or independent study. Midyear applicants are expected to complete all the requirements set forth for fall admission. The application deadline for new candidates is October 15; students will be notified of the decision on their applications by November 15 with the expectation that those who are accepted will reply by December 1.

Admission by Transfer. Admission by transfer from other accredited institutions may be arranged for a limited number of students each semester. Because a transfer applicant must present for review the transcript of a full year of academic work, and because transfer students are required to spend at least two years at Duke, most candidates apply to Duke during their third or fourth semester in college. Candidates submit, in addition to the normal application materials, official transcripts of all work completed at other accredited colleges, scores on the Scholastic Aptitude Test of the College Entrance Examination Board, and employment records if a candidate has been employed for an extended period since graduation from secondary school. See page 40 concerning evaluation of transfer credit.

Limited dormitory space makes it necessary for all transfer students to be responsible for their own housing arrangements.

September transfers observe a March 1 application date; decisions are mailed by May 1. January transfers apply by October 15 and learn of their decisions by November 15.

Nondegree Students. A small number of nondegree students may be admitted for enrollment in such courses of instruction as their earlier training and experience may qualify them to take. A candidate for admission to nondegree status applies directly to the Office of Undergraduate Admissions. The application should be filed a month in advance of registration. A $20.00 fee is charged. Students who are admitted to nondegree status may not apply for acceptance as candidates for a degree until eight courses are successfully completed and all the normal requirements for admission are met. For further information, see the section on the Center for Continuing Education.

Readmission of Former Students. A student who desires to return, following withdrawal from college, should apply to the dean of his college. The student will be asked to send a detailed statement of his activities since withdrawal, a transcript of academic work taken, and recommendations. (See page 46 for readmission procedures and dates.) Students who have been withdrawn from the University for five or more years must submit a new application.

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Financial Information

Tuition and Fees

The prospective student who seeks the optimum opportunity in higher education will not be a bargain hunter. Certainly, some sound plan for paying the cost of college must be devised, but this plan should be formulated after the thoughtful selection of an institution has been made. No college or university can honestly say that an education at the college level is inexpensive. Most university people and the ever-growing college alumni families across the country, however, will express the belief that the benefits derived from a college education constitute a handsome return on the dollars invested.

Each prospective student should analyze carefully his financial situation. In making such analysis it should be recognized that the primary responsibility for defraying the cost of an education lies with the student and his family. The typical college student can depend upon some contributions from his family's current income, a proportionate share of family savings, and anticipated income from summer employment. The number of years of study contemplated and the number of dependent children in the family should be considered in computing the funds which will be available in a particular year.

Fees paid by the students cover only a part of the cost of their instruction and the operations of the University. Income from endowment and contributions from the alumni and other public-spirited men and women meet the balance, which constitutes more than half the total cost.

Estimated Expenses for an Academic Year.* Certain basic expenditures are to be considered in preparing a student's budget such as tuition, room, and board. These necessary expenditures together with a reasonable amount allotted for miscellaneous items such as books and supplies are shown below:

Tuition	$2600.00
Residential Fee	
Single room	450.00-666.00
Double room	340.00-502.00
Food	
Seven-day board plan	680.00
Five-day board plan	580.00
Cafeteria estimate	750.00
Books and Supplies	175.00

*All rates subject to increase for 1973-74.

It should be realized that additional expenses will be incurred which will depend to a large extent upon the tastes and habits of the individual. It is realistic to suggest that the average Duke student, however, can plan on a budget of $4,500.00 for the academic year. Travel costs, clothing purchases, and other major expenditures would have to be added to this estimate.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Bills may be sent to parents or guardians provided the Bursar has been requested in writing to do so. Failure to pay bills on or before the due dates wil bar the student from class attendance until the account is settled in full.

Tuition. The tuition charge of $1,300.00 per semester ($2,600.00 for the academic year) is due and payable not later than the day preceding the first day of classes for a particular semester.

Registration Fees and Deposits. New students, on notification of acceptance, are required to pay a nonrefundable first registration fee of $20.00 and to make a deposit of $100.00. The deposit will not be refunded to accepted applicants who fail to matriculate. For those who do matriculate, $50.00 of the deposit serves as a continuing room deposit for successive semesters, and the remaining $50.00 serves as a continuing registration deposit.

Readmission. Students who have been readmitted to the University after an absence of one or more semesters, on notification of readmission, are required to make the $100.00 room and registration deposit.

Late Registration. Students who register in either semester at a date later than that prescribed in the Calendar must pay to the Bursar a fee of $10.00.

ROTC Deposit. An Air Force ROTC deposit of $10.00 is required of students enrolling in air science to cover possible loss of military equipment issued to them. This deposit is refunded to the student upon return of issued equipment.

School of Nursing. Special nonrefundable laboratory and health fees are charged as follows: sophomores—$50.00; juniors—$25.00; seniors—$50.00. Additional medical fees may be required for certain nursing electives.

Part-time Students. In the regular academic year students who register for no more than two courses in a semester are classified as part-time students. Part-time students will be charged at the following rates: One course, $260.00; half-course, $130.00; quarter-course, $65.00; one course plus laboratory or precept, $345.00. Registration for more than two courses requires payment of full tuition. Graduate students registered for undergraduate courses will be assessed 3 units for non-laboratory courses and 4 units for laboratory courses.

Auditors. Auditing of one or more courses without charge is allowed students paying full fees, provided that the consent of the instructor is obtained. Students who are enrolled for one or two courses may audit other courses by payment of $40.00 for each course audited. With the consent of the appropriate instructor and the Registrar, graduates of Duke may audit undergraduate courses for $40.00 for each course.

Duke Employees. Certain full-time employees with two or more years of service with the University may request permission to take for credit or audit up to two courses during any one semester. Permission may be granted based on the individual merits and circumstances of each application. Employees receiving permission to take such courses for credit will be charged one-half of the tuition rate for part-time students as shown above. Courses may be audited upon payment of $40.00 per course.

Fees for Transcripts. Requests for transcripts should be directed to the Office of the Registrar. Ten days should be allowed for processing. A minimum fee of $2.00, payable in advance, is charged for a single copy. A charge of fifty cents will be made for each additional copy on the same order.

Fees for Course Changes. Changes in courses for reasons not arising within the University require a payment of $1.00 for each change made. No course may be elected later than one week after classes begin without the instructor's approval, and no student may be admitted to any class without an official enrollment.

Living Expenses

Housing. In the residence houses for undergraduate students other than nurses, the residential fee for a single room ranges from $603.00 to $734.00 for the academic year; for a double room, the fee ranges from $450.00 to $548.00 per occupant. Information concerning the student's obligations under the housing contract is published in the *Bulletin of Information and Regulations.*

The residential units of the School of Nursing are Hanes House and Hanes Annex. The residential fee for a single room is $658.00 for the academic year; for a double room, it is $491.00 for each occupant. In the Graduate Center, the residential fee for a single room is $497.00 for the academic year; for a double room, it is $371.00 for each occupant.

Detailed information concerning the students' obligations under the housing contract and the consequences of failure to comply are published in the *Bulletin of Information and Regulations.*

Food Services. See Food Services on page 59 for a description of dining facilities on both campuses and the options or requirements for board contracts. The charge for board is $340.00 per semester on the seven-day plan or $290.00 per semester on the five-day plan, payable at the time of registration.

Refunds

If a student withdraws, he or his parents may elect to have tuition, as well a room and board (if applicable), held as credit for later study, or refunded according to the following schedule:

Withdrawal	*Refund*
Before classes begin	Full amount
During first or second week	80%
During third to fifth week	60%
During sixth week	20%
After sixth week	None

In the event of death, or involuntary withdrawal to enter the armed services refunds will be made on a pro rata basis.

The $50.00 registration deposit will be refunded to students (1) whom the University does not permit to return, (2) who graduate, or (3) who request the refund prior to registration, thus indicating their intention not to return for the following semester. The registration deposit will not be refunded to students who register but fail to enter the following semester on schedule.

Arrangements for refund of the $50.00 room deposit are described in information furnished each student by the Housing Bureau.

Student Aid

It is the policy of Duke University to provide adequate financial aid for all students when evidence of need exists. The amount of financial assistance approved for an individual varies directly with his financial need determined according to widely accepted principles recommended by the College Scholarship Service.

For the student with demonstrated need, the net cost of an education at Duke University will generally be no greater than that for college attendance at a private institution elsewhere. It is the intention of the Financial Aid Office to set each award at a level which will enable a student to meet all the costs of attending Duke University, taking into consideration the contribution that can reasonably be expected from the student, his family, and any available outside sources.

During the current academic year, approximately one-third of the student body received more than three million dollars in scholarships or loan funds.

Financial Aid for Entering Freshmen. Financial aid candidates should initiate their application for financial aid concurrently with their application for admission during the fall semester of their senior year in secondary school. Instructions concerning the specific requirements and deadline dates will accompany the application materials. The Parents' Confidential Statement must be submitted to the College Scholarship Service. This form may be obtained either from a high school guidance counselor or from the Financial Aid Office, 614 Chapel Drive, Durham, N. C. 27706.

A student in residence who is receiving financial assistance based upon need may not register an automobile on campus during the academic year for which the aid is granted without special permission for an appropriate reason.

Renewal of Financial Aid after Freshman Year. Each year students must file an application for renewal of financial aid. This application must include a new Parents' Confidential Statement and a certified copy of the parents' current Federal Income Tax Form 1040.

In order for financial aid to be renewed, a student must be in good academic tanding with the University (at least a *C* average). A. B. Duke and J. A. Jones cholars are expected to maintain a higher average. If it is necessary for a student receive an *I* (incomplete), an *X* (absence from final examination), or a *W* withdrawn) on his report, he is advised to see his academic dean.

Types of Financial Aid. Gift scholarships or grants, long-term loans, and mployment are integral parts of the financial aid program, and some portion of he aid offered an undergraduate will normally be in each of these forms. In 1972-73, the self-help portion will consist of $600 and a job paying $600. Accepance of a gift scholarship does not require the student to undertake the loan or ob portions of his award. Duke has many scholarships based on need which are vailable annually from personal endowments and corporation sources. Some are esignated for entering freshmen, while others are awarded to upperclassmen. These cholarships may be based upon achievement in a particular field or an overall outtanding record.

Gift Scholarships. The following are the named gift scholarships offered hrough Duke University:

Angier B. Duke Memorial Scholarships. Recipients of these awards are students whose superior records mark them as young men and young women who give outstanding promise of becoming leaders in their chosen fields of endeavor. Candidates for admission to the freshman classes in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing are eligible to apply. Forty are usually available for each freshman class with a value of $500.00 to $4,300.00 annually, depending upon financial need.

W. N. Reynolds Memorial Scholarships. Recipients of these awards are students of outstanding ability and need who have made superior records and show promise of constructive leadership. In considering candidates for the awards, consideration will be given in the following order:

1. Children of employees of R. J. Reynolds Tobacco Company or any of its affiliates or subsidiaries.
2. Children of families residing in Forsyth County, North Carolina.
3. Other candidates who are residents or natives of North Carolina.

Number available: Four for each freshman class.
Value: $500.00 to $4,300.00 annually.

United Methodist Scholarships. A number of United Methodist Scholarships, valued at $500.00 per year, are available on a basis of demonstrated need to Methodist students who have given evidence of leadership in their local Methodist Youth Fellowship Groups.

Christian Vocations Scholarships. Students preparing to enter full-time religious work are eligible to apply for special consideration on the basis of need. These students will be required to submit the Parents' Confidential Statement. Students with need will be recommended by the Director of Undergraduate Financial Aid to the Christian Vocations Scholarship Committee which will consider the vocational commitment of the applicant. Students approved by the Christian Vocations Scholarship Committee are required to sign a note each semester for the amount of financial assistance granted. These notes will be cancelled upon evidence that the student has entered full-time Christian work after graduation.

Alice M. Baldwin Scholarships. One or more of these scholarships, varyin in amount from $200 to $2,000, are awarded to rising seniors in Trinity Colleg of Arts and Sciences on the basis of scholarship, character, and leadership.

Woman's College Memorial Scholarship. The Woman's Residence Counc established in 1972 a Woman's College Memorial Scholarship Fund. From thi fund one or two awards, of approximately $500 each, may be made annually t undergraduate women who have made significant contributions to the academ and residential life of the University.

Evelyn Barnes Memorial Scholarship. One $400 or two $200 grants ar awarded to women students in any class of Trinity College of Arts and Science who are contributing to the musical life of the University. Scholarship, characte and leadership are considered. Recommendation by a member of the music facult or by the Director of the Chapel Choir is required.

Panhellenic-Sandals Scholarship. A scholarship of $500 is awarded t an upperclass woman student in Trinity College of Arts and Sciences on the basi of scholarship, character, leadership, and service.

Delta Delta Delta Scholarship. A scholarship of $200 is awarded by Delt Delta Delta to a woman student in Trinity College of Arts and Sciences on th basis of scholarship and character. The winner of this award is eligible to compet for the national award of a Delta Delta Delta Scholarship of $1,000.

Welch Harriss Scholarships. These awards are made to male freshmen wh have achieved outstanding academic records and who demonstrate financial need They are renewable each year as long as the student remains in good academi standing. Consideration will be given in the following order: (1) students fro High Point; (2) students from Guilford County, North Carolina; and (3) student from North Carolina. Number available: Three for each freshman class.

Florence K. Wilson Scholarships. Grants-in-aid are made each year fro the Florence K. Wilson Scholarship Fund to nursing students qualifying for financia assistance. This fund was established in 1961 by combining the School of Nursing' Alumnae Association Fund, the students' Florence K. Wilson Scholarship Fund, an contributions from the Wilson family and friends. The income from this fund provides scholarships for students in the School of Nursing.

Marian Sanford Sealy Scholarship Fund. Established in 1966 with a initial gift from the Durham-Orange County Medical Auxiliary, the Marian Sanford Sealy Scholarship is awarded to a student indicating financial need. Persona qualifications supportive of potential to become an outstanding nurse and a distinguished academic record are the criteria for the recipient of this scholarship.

Lelia R. Clark Scholarship in Nursing. The Duke Hospital Auxiliary established the Lelia R. Clark Scholarship in Nursing in 1971 to cover tuition and fees for a nursing student, preferably one from North Carolina. Prerequisites for the award are a commendable academic record, financial need, and exemplification of the qualities of a person committed to serving others.

National Institutes of Health Mental Health Training Grants. A limited number of Mental Health Training Grant Awards are available to qualified junior and senior student nurses. An award provides for an annual stipend plus tuition fees. Additional information about the Psychiatric Nursing Undergraduate

Training Grant Awards may be secured from the Dean of the School of Nursing. To qualify for an award, the student must have an above average academic record, potential for admission to graduate study, and declared intent to pursue a career in the field of mental health nursing.

J. A. Jones Memorial Scholarships. These scholarships, sponsored through the Jones Fund for Engineering, are awarded to engineering students whose outstanding academic and personal qualifications suggest that they will become leaders in a technological society. The awards range from a yearly sum of $500 to $3,600, depending on the degree of need. The Jones Scholarships are granted for the first year without regard to the student's intended major within engineering, and they are renewable on the same terms for the second year as long as the student does satisfactory work. For the last two years, they are limited to majors in civil engineering.

Robert H. Pinnix Scholarships. The Robert H. Pinnix Scholarships are awarded annually to two upperclassmen enrolled in the Duke School of Engineering. The award is based upon demonstrated ability, excellence in engineering, and financial need.

Scholarships for Foreign Students. A limited number of awards will be made each year to qualified students from other countries who enter either as freshmen or as students with advanced standing. Candidates for these awards are required to submit the Application for Scholarship and Financial Aid and the Parents' Confidential Statement of the College Scholarship Service provided by the Admissions Office of Duke University. There are two named awards to bring foreign students to the campus. They are the Carol Cranmer Scholarship (named for a former student) and the Roberta Florence Brinkley International Scholarship (named for a former dean).

The Mary Duke Biddle Scholarship in Music Composition. This scholarship at a fixed stipend of $2,500 per year is available to a member of each entering class. It is renewable from year to year so long as the student does satisfactory work. The student wishing to apply for this award will proceed in the norm manner but will be required to submit examples of his music composition. Elig bility is limited to students planning to major in music.

Huguenot Scholarship. A scholarship of $1,000 per year is available fro the Huguenot Society of America to a descendant of a Huguenot ancestor.

AFROTC College Scholarship Program. Beginning in the second semeste of their freshman year, cadets are eligible to compete for AFROTC Colleg Scholarships. These scholarships include tuition, books, laboratory fees, and $10 a month stipend. The scholarship is awarded on a merit basis and consider academic achievement, leadership potential, and overall performance. The scholar ship can become effective in the sophomore or junior year.

NROTC College Scholarship Program. This scholarship program provide for four years' tuition and textbooks at government expense plus subsistence an summer active duty pay. Selection for this program is made during the senio year in secondary school through a nationwide selection process.

Loans. The loan programs which are available to students through Duk University are listed below:

National Direct Student Loan Program. Loan funds supplied by the federa government through Part E of Title IV of the Higher Education Act of 1965 ar available to qualified students. Repayment of loans under this Act normally begin nine months after the student graduates or leaves college, with complete paymen scheduled within a ten-year period. Interest accrues at the rate of 3 percent annually commencing nine months after the borrower ceases to be a full-time studen at an institution of higher education.

Federal Guaranteed Insured Loan Program. Under the Higher Educatio Act of 1965 Congress established the Federal Guaranteed Insured Loan Program which is designed to guarantee and insure student loans. These loans are made b banks or other incorporated state lending agencies, with enrollment of the studen certified by the school or college. The interest is 7 percent. Students who qualif will have the interest paid by the government while they are in school. By the summer of 1973, Duke University will be a guaranteed lender.

Nursing Loans. Loan funds supplied by the federal government are available to qualified students in the School of Nursing. Interest accrues at the rate of 3 percent annually commencing nine months after the student ceases to be a full-time student. A certain percentage of the loan is forgiven for each year the student serves as a professional nurse.

Remission of Tuition. Children of ministers in the North Carolina and Western North Carolina Conferences and children of ministers of all faiths residing in and serving churches in Durham County are eligible to receive a remission of the tuition charge for a maximum of eight semesters of undergraduate study at Duke University.

Employment. Most financial aid recipients are offered a job as part of their aid package. These jobs require betwen nine and fifteen hours a week and provide an average stipend of $600. The money is paid directly to the student and is not available to the Bursar's Office for credit on the student's account.

The Undergraduate Financial Aid Office serves as a clearinghouse for all Duke students desiring part-time jobs both on the campus and in the city of Durham.

Duke University also expects that students receiving financial aid will work during their summer vacation. In the summer before entering college, a freshman hould save $400 for use during his first year of college. In subsequent summers, he student should save $600 to be used for college expenses.

Paying the Bill. Many families finance a college education with the assistance of an insured tuition payment plan regardless of whether they receive financial assistance from Duke. Although these plans are sponsored by a number of private irms, the University refers parents to the plans provided by the Richard C. Knight nsurance Agency, Inc. The company provides the University with the full sum equired each semester and arranges a schedule for monthly repayment by the subcribing families. The schedules for repayment vary with the programs offered by the company. Additional information on this particular tuition payment plan may be obtained by writing to Richard C. Knight Insurance Agency, Inc., Insured Tuition Payment Plan, Sixth Street-James Avenue, Boston, Massachusetts 02116.

8

Courses of Instruction

Definition of Terms

Introductory-level courses are numbered below 100; advanced-level courses re numbered 100 and above. Courses numbered 1 through 49 are primarily for eshmen; courses numbered from 200-299 are primarily for seniors and graduate udents. (See page 39 for regulations governing enrollment of other students in e two latter categories of courses.)

Odd-numbered courses are usually offered in the fall semester; even-numbered urses in the spring semester. For courses which will be offered in 1973-74, conlt the Official Schedule of Courses, available to enrolled students in the Registrar's ffice.

Double numbers separated by a hyphen indicate that the course is a year-ourse and must normally be continued throughout the year if credit is to be reeived. A student must secure written permission from the instructor in order to eceive credit for one semester of a year-course. Double numbers separated by a omma indicate that although the course is a year-course, credit may be received r either semester without special permission.

When *S* is prefixed to course numbers a Summer School offering is designated. he following symbols, suffixed to course numbers, identify "the small-group earning experiences": *S*, seminar; *P*, preceptorial; *T*, tutorial; *D*, discussion section. (For a description of these various course formats, see pages 12-13.)

Air Force Aerospace Studies

For courses in Air Force Aerospace Studies, *see* the Reserve Officers Training Program.

Anthropology

Associate Professor Fox, *Acting Chairman;* Assistant Professor Casson, *Director of Undergraduate Studies;* Professor LaBarre; Associate Professor Apte; Assistant Professors Cartmill, Hylander, O'Barr, and Quinn; Instructor Kress

93. Human Origins. Origins and distribution of mankind; primate evolutio a survey of human paleontology and human biology, prehistory and language; an the origins of human social organization and culture. One course. *Staff*

93D. Same course as 93 with discussion section included. One cours *Staff*

93S. Same course as 93 taught as seminar. One course. *Staff*

94. Cultural Anthropology. A study of the dynamics of culture and societ form and function of social institutions. Emphasis is upon primitive societies. Or course. *Staff*

94D. Same course as 94 with discussion section included. One course. *Sta*

94S. Same course as 94 taught as seminar. One course. *Staff*

101, 102. Introduction to the Civilization of Southern Asia. (See Inte disciplinary Course 101, 102.)

119. Language, Culture, and Society. Analysis of language behavior withi and across societies relating variations in linguistic usage to sociocultural factor ethno-semantics, social dialects, ethnography of speech, language standardizatio multilingualism, language loyalties, problems of lingua franca, language plannin and policies in developing nations. Prerequisite: permission of the instructor. On course. *Apte and Casson*

120. Comparative Language. Anthropological study of human and pr human non-verbal communication; sound, sense, and structure in Indo-Europea and other languages; techniques of reconstructing the ethnographic past (philolog glottochronology, paleolinguistics); and an introduction to psycholinguistics an sociolinguistics. One course. *LaBarre*

121, 122. World Ethnography. The major cultural areas of the world i terms of the "universal culture pattern." Ethnographic records are used to illustrat and appraise non-Western man's environment. Two courses. *Staff*

124. Peoples of the World: American Indian. A comprehensive survey the Indians of North and South America, including a study of origins and pr history, archaeology, racial affiliations, languages, material culture, social an political organization, economics, and religion, discussed in terms of the "cultur area." One course. *LaBarre*

125. Peoples of the World: Africa. A survey of the indigenous cultures an societies of Africa. Particular emphasis will be given to the study of kinship, pol tics, economics, religion, and sociocultural change. One course. *O'Barr*

126. Peoples of the World: Oceania. Selected problems in the developme of pre-European and post-European cultures. The relationships between man an Pacific environments. One course. *Kress*

128. Peoples of the World: Asia. A comprehensive survey focusing on th peoples and societies of South, Southeast, and East Asia, including the prehistori ethnic, linguistic, religious, and political foundations of the complex civilization the response of traditional Indian, Chinese, and Japanese cultures to the Wes One course. *Apte and Fox*

129. Peoples of the World: Middle East. Emphasis on language, kinshi economics, politics, and religion. One course. *Casson*

130. Cultural Change and Stability. Contemporary theories of culture hange, especially those resulting from acculturation and from implementation f programs of technical and economic aid; a consideration of the factors significant ı maintaining stability or stimulating change in traditional cultures. Prerequisite: nthropology 94 or permission of the instructor. One course. *Staff*

134. Political Anthropology. Comparative study of conflict and political ction. Decision-making as related to social structure and cultural values. Stateess, emergent, and underdeveloped societies. Prerequisite: Anthropology 94 or ermission of the instructor. One course. *O'Barr*

135. The Ethnography of Complex Societies. Sub-structures in American ociety studied by ethnographic field methods. Prerequisite: Anthropology 94 or ermission of the instructor. One course. *Quinn*

137. Comparative Social Organization. Social anthropological analysis of ole structures and corporate groups in particular societies, and their relevance or understanding the historic process of civilization. Case study of social types nd of the unique features of societies revealed by the comparative method. Preequisite: Anthropology 94 or permission of the instructor. One course. *Casson*

162. Introduction to Ecological Anthropology. Behavioral and other bioogical adaptations in human populations; man-dominated ecosystems in the primiive world. Prerequisite: Anthropology 93. One course. *Casson*

164. Peasantry and Peasant Movements. The genesis of peasant movenents. Forms of peasant protest and its role in the economic, political, and ritual ife of societies. Case studies from Western and Eastern societies, past and present. rerequisite: Anthropology 94 or permission of instructor. One course. *Fox*

165. Psychological Anthropology. The mutual relevance of anthropology nd the following areas of psychology: child development, social learning, small roup interaction, cognition. Prerequisite: Anthropology 94 or permission of the nstructor. One course. *Quinn*

166. Introduction to Archaeology: Man and Culture. Modern methodolgy and analysis; theories of cultural evolution; survey of world prehistory with n exploration of the uses of ethnographic analogy. One course. *Kress*

185S, 186S. Junior Tutorial. Prerequisites: Anthropology 94 and permision of the Director of Undergraduate Studies. Half-course or one course. *Staff*

193. Independent Study. Directed reading and research. Open only to ighly qualified students in the senior year, by permission of the Director of Underraduate Studies. One course. *Staff*

195S, 196S. Senior Seminar. Prerequisites: Anthropology 94 and any two 100-level courses in anthropology, and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

199S. The Changing South. (See Interdisciplinary Course 199.)

220S. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. One course. *Fox and Apte*

222S. Topics in African Anthropology. Current research problems i African anthropology, illustrated by a study of tribal societies, in terms of conten porary theories. One course. *O'Barr*

231. Human Evolution I. Evolutionary biology of the primates. An tomical, behavioral, and molecular adaptations of fossil and living primate popul tions including *Homo sapiens.* Prerequisite: a course in biology or consent c instructors. (Also listed as Zoology 131.) One course. *Buettner-Janusch an Cartmill*

231D. Human Evolution I. Same as 231 with discussion period include One course. *Buettner-Janusch and Cartmill*

232. Human Evolution II. Human population and biochemical genetic Analysis of the effects of natural selection on past and present human population Prerequisite: Anthropology 231 (Anatomy 231, Zoology 131) or consent of in structor, or a course in genetics. (Also listed as Zoology 132.) One course *Buettner-Janusch*

232D. Human Evolution II. Same as Anthropology 232 with discussio period included. One course. *Buettner-Janusch*

236. Human Genetics. Emphasis upon the uniqueness of studies in huma clinical, biochemical, and population genetics. (Also listed as Anatomy 236 Zoology 236, and under the Genetics Program in the *Bulletin of the Graduat School.*) Prerequisites: Anthropology 231 (Anatomy 231, Zoology 131), or a elementary course in biology including genetics, or permission of instructor. On course. *Buettner-Janusch*

236D. Human Genetics. Same as Anthropology 236 with discussion perio included. One course. *Buettner-Janusch*

240S. Indo-Aryan Linguistics. Historical development of Indo-Arya languages from Sanskrit to the modern period. A comparative analysis of moder Indo-Aryan languages as regards phonology, morphology, syntax, and lexicon. Im pact of non-Indo-Aryan languages on the structure and lexicon of Indo-Arya languages. Prerequisite: English 107 or permission of instructor. One course *Apte*

242S. Topics in Prehistory. Anthropological issues derived from archeological and early historical investigations. Prerequisite: Anthropology 93 and 9 or equivalent. One course. *Kress*

243S. Theory and Method in Archaeology. Techniques of geochronology, environmental reconstruction, sociocultural reconstruction and statistical analyses applied to problem areas in archaeology—human cultural origins, lower- to mid- and mid- to upper-paleolithic, post Pleistocene readaptations, origins o agriculture and civilization. Prerequisite: Anthropology 166 or permission o the instructor. One course. *Kress*

245. Functional and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens.* (Same as Anatomy 238.) Prerequisites: Anthropology 231 (Anatomy 231, Zoology 131) or equivalent, or consent of the instructor. One course. *Hylander and Cartmill*

246. The Primate Fossil Record. Evolution of man and other primates as inferred from fossil remains. Prerequisite: a course in human evolution or permission of instructor. One course. *Cartmill and Hylander*

249S. Economic Anthropology. Economic organization and behavior in pre-literate, peasant, and transitional societies; analysis of ownership and distribution. The relationship of economic processes to norms and institutions such as markets. Prerequisite: Anthropology 94 or permission of the instructor. One course. *O'Barr and Quinn*

250S. The Anthropology of Cities. Organization and behavior of men in urban centers analyzed from an evolutionary perspective; cross-cultural analysis of cities and their varying roles. One course. *Fox*

259S. Linguistic Anthropology: Language Acquisition. Biological basis of human linguistic capacity; major theoretical positions in linguistics; acquisition of semantics, syntax, and phonology in English and other languages. Prerequisite: permission of the instructor. One course. *Casson*

260S. Linguistic Anthropology: Phonemics. Application of descriptive linguistics to analysis of language; concentration on the sound system of non-Western languages. Prerequisite: permission of the instructor. One course. *Apte and Casson*

261S. Linguistic Anthropology: Morphology and Syntax. Application of descriptive linguistics to analysis of language; concentration on the grammatical system of non-Western languages. Prerequisite: Anthropology 260 or permission of the instructor. One course. *Apte and Casson*

262S. Anthropology of Law. Legal decision in pre-literate societies. The interrelationships of law and ritual. One course. *Staff*

263S. Primitive Art and Music. A comparative ethnological study of non-European art and music; sufficient technical background will be provided for non-specialist students. One course. *LaBarre*

264S. Primitive Religion. The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. One course. *LaBarre*

265S. Personality and Society. The sociology and social psychology of human personality, its origins in the primary group, its nature and varieties, and its integrations into secondary group institutions. One course. *LaBarre*

266S. Personality and Culture. The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comprehensive anthropological materials will be drawn upon. One course. *LaBarre*

270S. Seminar in Ethnographic Field Methods. Research strategies and techniques for field research; participation in a field project in a local community. One course. *O'Barr*

271S. Seminar in Methods of Data Analysis. Quantitative analysis of anthropological data. One course. *Quinn*

275. Rank, Power, and Authority in Pre-Industrial Societies. The role and development of social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. Prerequisite: concentration i anthropology or graduate standing. One course. *Fox and Quinn*

276S. Analysis of Kinship Systems. Primitive relationship categorie as related to legal norms and social groupings. Theoretical issues and contrastin approaches to the analysis of social classification terminologies. One course *Casson*

278S. Special Topics in Political Anthropology. Current research problems in political anthropology. Topic(s) will change each semester. Prerequisite Anthropology 134 or permission of instructor. One course. *O'Barr and Quin*

280S, 281S. Seminar in Selected Topics. Special topics in methodology theory, or area. Prerequisite: permission of the instructor. Two courses. *Staff*

291S, 292S. Anthropological Theory. Theoretical, methodological, an comparative issues in anthropology. Two courses. *Fox and Quinn*

DEPARTMENTAL MAJOR

Prerequisite. Anthropology 93-94.

Major Requirements. Six courses in the department above 93-94, includin at least two senior-graduate courses.

An anthropology major normally takes at least four related courses i departments approved by his anthropology adviser. Such courses are usuall in the Departments of Anatomy, Art, Botany, Economics, History, Mathematics Political Science, Psychology, and Zoology.

Art

Professor Covi, *Chairman;* Professor Jenkins, *Director of Undergraduate Studies* Professors Hall, Heckscher, Markman, Mueller, and Sunderland; Assistant Professors V. Pratt and Stars; Instructor Smullin; Lecturer Langedijk; Visiting Lecture Brown; Part-Time Lecturer van Dijk; Part-Time Instructors Menapace, S. Pratt and White

HISTORY OF ART

Introductory courses in art history (Art 61 through 66) are designed a studies in the development of architecture, sculpture, painting, and minor arts a material manifestations of Western culture from ancient to modern times, wit some reference to primitive, Oriental, and other non-Western cultures. A studen receives an introduction to the history of art and to methods of art historica analysis through either (*a*) the study of a major area (Art 61 or 62) and a majo period (Art 63, 64, 65, or 66), or (*b*) two major periods. Only one area cours may be taken for credit and no more than two courses in the entire sequence ma be taken for credit. Introductory courses are open to freshmen, sophomores, an juniors.

Area Courses

61. Introduction to the History of Architecture and Sculpture. (No open to students who have taken Art 62.) One course. *Staff*

62. Introduction to the History of Painting and Sculpture. (Not open to students who have taken Art 61.) One course. *Staff*

63. Introduction to Ancient Art. Architecture, sculpture, and painting from prehistoric times through the Roman period. One course. *Markman*

64. Introduction to Mediaeval Art. Development of architecture, sculpture, painting, and related arts, mostly Christian, from about 300 A.D. to about 1400 A.D. One course. *Sunderland*

65. Introduction to Renaissance and Baroque Art. Development of architecture, sculpture, and painting in Western Europe from about 1400 to about 1750. One course. *Jenkins*

66. Introduction to Modern Art. Development of architecture, sculpture, and painting in Europe and America from about 1750 to the present. One course. *Brown*

119. Fine Arts Photography Laboratory. History and development of photography as documentation and art, use of materials, techniques, laboratory, and studio practice. Open to art majors or by permission of instructor. A fee of $25.00 will be charged, payable upon notification from the Bursar's Office at the beginning of the semester. Half-course. *van Dijk*

131. Art and Archaeology of the Hellenic World. Preliminary treatment of archaeological material from the Aegean, the geometric, and orientalizing periods, followed by the architecture, sculpture, and vase paintings of ancient Greece from archaic through Hellenistic times. Not open for credit to students who have taken Classical Studies 55. One course. *Markman*

132. Roman Art and Archaeology. The archaeological background for the formation of the Roman style as derived from Etruscan, Greek, and indigenous Italian sources, followed by the architecture, sculpture, and painting from the early Republic to the end of the empire in Italy, and in the provinces. Not open for credit to students who have taken Classical Studies 56. One course. *Markman*

133. Mediaeval Architecture. A survey of Christian architecture in the Near East, the Balkans, Russia, and Western Europe from the beginnings of the mediaeval style in the late classical period to its disintegration in the fifteenth century. One course. *Sunderland*

134. Mediaeval Painting and Sculpture. A study of painting, including mosaics, manuscripts, stained glass, and sculpture in Western Europe from the late classical period through the fourteenth century. One course. *Sunderland*

135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries. First semester: Netherlandish, French, and Spanish painting with some reference to Franco-Flemish illumination. Second semester: German, Austrian, and Bohemian painting, graphic arts, and sculpture. Two courses. *Mueller*

137, 138. Italian Renaissance Art. A consideration of Italian sculpture and painting in the fourteenth, fifteenth, and sixteenth centuries. The first semester will be devoted to the art of the fourteenth and fifteenth century; the second to that of the sixteenth century. Two courses. *Jenkins*

139S. The Book as an Art Form. From hieroglyphic inscriptions to press books, with particular emphasis upon the relationship of book manufacture and design to its cultural environment. One course. *Sharpe*

140. Seventeenth Century Painting and Sculpture in Europe. Thi course traces the evolution of the Baroque style in European painting and sculpture, with some attention being given to related manifestations in the late sixteent and early eighteenth centuries. Particular emphasis is laid on developments i Flanders, France, Holland, and Spain. Prerequisite: Art 61 or 62 or 65 or consen of instructor. One course. *Jenkins*

141. American Art. A survey of architecture, sculpture, and painting i America from the time of the first settlers to the present day, including a consideration of the contributions of the English, Dutch, French, and Spanish to the artistic heritage of the United States. One course. *Brown*

143S. History of Prints and Drawings. Fifteenth century to the present. Prerequisite: Art 62, 65, or 66, or consent of the instructor. One course. *Muelle*

144. Renaissance and Baroque Architecture. A study of the development of Renaissance architecture in Italy from its beginnings in the fifteenth century in the works of Brunelleschi to its flowering in the seventeenth century Baroque works of Bernini and Borromini, along with a consideration of the spread of Italian Renaissance forms to north Europe in the sixteenth century and its development into a Baroque style in the seventeenth century. One course. *Sunderland*

145S-146S. The Rise of Contemporary Architecture. A study of the sources and evolution of the architecture of today, from the eighteenth century conflict between romantic historicism and industrialism to the work of Gropius, Le-Corbusier, Wright, and their successors. Seniors graduating at midyear may receive credit for 145, which is otherwise prerequisite to 146. Two courses. *Hall*

147. Painting and Sculpture in the Eighteenth and Nineteenth Centuries. An investigation of the development of painting from the final stages of the Baroque in the eighteenth century to the period of the Impressionist Movement in the last decades of the nineteenth century. One course. *Sunderland*

148. Modern Painting and Sculpture: 1863 to 1905. The rise of the anti-academic movement of Impressionism, Divisionism, Symbolism, and the Art Nouveau, emphasizing Manet, Van Gogh, Gauguin, Seurat, and Cezanne. One course. *Brown*

149. Pre-Columbian Art and Archaeology. Architecture, sculpture, pottery, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region of South America before the Spanish conquest. One course. *Markman*

150. Latin American Art. Architecture, painting, sculpture, and other arts. Emphasis on the architecture of the colonial period. One course. *Markman*

165. Painting and Sculpture: 1905 to Present. Evolution and interaction of major European and American movements. One course. *Brown*

191T, 192T. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission of the department. Two courses.

193T, 194T. Independent Study. Directed reading and research. Open only to qualified students in the senior year, by permission of the department. Two courses.

For Seniors and Graduates

217S. Aegean Art. A study of the problems of Aegean art as the forerunner of Greek art and in relation to the contemporary civilization of the Eastern Mediterranean world. One course. *Markman*

218S. Early Greek Art. A study of the problems of the origin and development of Greek art in the Geometric period to the end of the Archaic period. One course. *Markman*

233. Early Mediaeval Architecture. The development of religious architecture from the time of Constantine to the end of the first romanesque style in the third quarter of the eleventh century. One course. *Sunderland*

234. Romanesque Sculpture. The development of sculpture in Western Europe from the early Christian period through the culmination of romanesque art in the west portal of Chartres Cathedral. One course. *Sunderland*

237. French Renaissance Art. Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French, or consent of the instructor. One course. *Jenkins*

238. Sienese Painting. Painting in Siena in the late Middle Ages and the Renaissance. Prerequisite: open to majors in history of art, or consent of the instructor. One course. *Jenkins*

239. Architecture of Britain. After a summary of recent archaeological activity in the British Isles and a survey of mediaeval buildings, the course deals principally with changing architectural problems and their solutions from the advent of the Renaissance onward. Attention is given to the interests of students majoring in history or literature. One course. *Hall*

240. Architecture of North America. A study illustrating the transplantation of European architectural customs since the sixteenth century; the time lag in transit and acceptance of later European developments; the gradual assumption of confident independence in design; and the emergence of international leaders in the United States. One course. *Hall*

241. Problems in Latin American Art. Architecture, painting, sculpture, and other arts with emphasis on colonial architecture of Central America. Open to seniors who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. One course. *Markman*

247. Problems in the History of Graphic Arts. Selected topics in the history of prints and drawings. One course. *Mueller*

248. Florentine Painting During the Renaissance. Prerequisite: Art 137 or 138 or consent of instructor. One course. *Covi*

251S-252S. Research. A course designated to give instruction in methods used in the investigations of original problems. It is open to seniors by permission of the Director of Undergraduate Studies. Two courses. *Heckscher*

253S. Studies in Italian Renaissance Sculpture. One course. *Covi*

255S, 256S. Iconological Problems. Subject matter and sources. Two courses. *Langedijk*

291S-292S. Museology Seminar. Operation of a museum; instruction i exhibition and restoration techniques, as well as registration and the researchin of art objects with a view to exhibition accompanied by scholarly catalogues. Ope to art majors or consent of the instructor. Two courses. *Heckscher and Staff*

293, 294. Special Problems in Art History. Individual study and researc Two courses. *Staff*

DESIGN

53-54. Beginning Studio. Experiment and practice with formal element of composition in various media. Prerequisite: consent of the instructor. Tw courses. *Pratt and Smullin*

151. Photography. Emphasis on interaction of technique, perception, an communication in making and responding to photographic images. Some wor with view cameras furnished by the department; students must provide own han camera. Prerequisite: consent of instructor. One course. *Menapace*

153, 154. Painting. Individual and group criticism and discussion of im portant historic or contemporary ideas in painting. Prerequisites: Art 53-54 an consent of the instructor. Two courses. *Pratt*

155, 156. Advanced Drawing and Color. Prerequisite: Art 53-54. Tw courses. *Pratt*

159, 160. Printmaking. Wood engraving, block printing, copperplat engraving, etching, aquatint, and drypoint. Prerequisite: Art 53-54. Two courses *White*

161, 162. Sculpture. Realistic modeling in clay from the human mode and work in abstract modes. Introduction to casting, carving, and welding. Secon semester: independent problems. Prerequisite: Art 53, 54, or consent of th instructor. Two courses. *Smullin*

164. Ceramics. The design, production, and conceptualization of three-dimensional forms. One lecture and four studio hours each week. One course. *Stars*

173, 174. Advanced Painting. Prerequisites: Art 153 and 154. Two courses. *Pratt*

181, 182. Individual Project. Independent work open to highly qualified seniors on recommendation of the instructor and invitation of the department. Two courses.

DEPARTMENTAL MAJOR

The student will elect a sequence of courses emphasizing either the history of art or design.

Major in History of Art

Prerequisites. Introduction to art history, two courses (61 or 62 and one course from 63, 64, 65, or 66, or two courses from 63, 64, 65, or 66).

Major Requirements. Eight courses in art history exclusive of 61 through 66 and including no fewer than two courses at the 200-level.

Major in Design

Prerequisites. Introduction to art history, two courses (61 or 62 and one course from 63, 64, 65, or 66. or two courses from 63, 64, 65, or 66). Art 53-54, two courses.

Major Requirements. Five studio courses exclusive of Art 53-54.

The department offers work leading to graduation with distinction. See the section on honors in this *Bulletin.*

Studio Fees. A fee of $25.00 per semester will be required in all studio courses, including Art History 119, to cover materials used in each course. The fee is payable upon notification from the Bursar's Office at the beginning of each semester.

Asian and African Languages

CHINESE

131, 132. Intensive Elementary Chinese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

133, 134. Intensive Intermediate Chinese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

135, 136. Introduction to Modern Chinese Literature. Prerequisites: Chinese 133 and 134 or equivalent. Two courses. *Rolf*

HINDI-URDU

171, 172. Studies in Indian Literatures. Readings in translation. First semester: classical Indian literary traditions. Second semester: literatures from Indian languages, including novels, poetry, and drama, with special reference to European literary influences. Two courses. *Shonek*

181, 182. Intensive Elementary Hindi-Urdu. Four hours of classroom work; two hours of language drill. Concentration on the acquisition of conversational ability in Hindi-Urdu, with a grammar and vocabulary basic to both Hindi and Urdu. Introduction to the Devanagari script and the reading of graded texts. Two courses. *Smith*

183, 184. Intensive Intermediate Hindi-Urdu. Four hours of classroom work; two hours of language drill. Advanced conversation in Hindi-Urdu reading and composition. Prerequisite: elementary Hindi-Urdu. Two courses. *Staff*

185, 186. Advanced Hindi Reading and Composition. An introduction to scholarly and literary Hindi prose and extensive practice in composition. Prerequisites: Hindi-Urdu 183, 184, or equivalent. Two courses. *Staff*

200, 201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized, graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. Two courses. *Staff*

These courses are offered as an enrichment program for students interested in the South Asian subcontinent and may be taken as general electives by advanced undergraduate students. No major work is offered in Hindi-Urdu.

JAPANESE

151, 152. Elementary Japanese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

153, 154. Intensive Intermediate Japanese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

155, 156. Introduction to Modern Japanese Literature. Prerequisite: Japanese 153, 154 or equivalent. Two courses. *Rolf*

161. Modern Japanese Fiction in Translation. Readings of twentieth century Japanese novels and short stories. One course. *Rolf*

SWAHILI

101, 102. Elementary Swahili. Three hours of classroom work, plus language drill. Two courses. *Little*

Biology

11-12. An Introduction to Biology. Adaptation and diversity of plants and animals; their evolution, ecology, structure, function, and significance to man and his environment. Open to entering freshmen who have had no more than one year of biological science in high school, and to upperclassmen only with the consent of a director of undergraduate studies in either botany or zoology. Lectures and laboratories. Two courses. *Staff*

11P, 12P. Preceptorials. Elective preceptorials for students enrolled in Biology 11, 12. *Staff*

14. An Introduction to Biology. Nature of plants and animals, their origin, evolution, and development. Introduction to major concepts and methodology relevant to current problems. Open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. (Offered in fall and spring terms.) One course. *Staff*

14P. Preceptorial. Elective preceptorial for students enrolled in Biology 14.

The above offerings, 11-12 and 14, may not both be taken for credit; either is an acceptable prerequisite for advanced courses. See other courses listed under *Botany* and *Zoology*.

Black Studies

Assistant Professor Burford, *Director;* Assistant Professors Gavins and Olela; Visiting Professor Jackson; Visiting Lecturer Allen, Dean and student adviser Wallace

Black studies is designed to provide instruction and study directed toward the concern and particular experience of Black America. Though intensive work (a major) is quite worthwhile and encouraged, Black studies recognizes many of its course offerings as important to most students' primary fields of endeavor as well as an essential component of the liberal arts education.

83, 84. Afro-American History. The Black experience in America from Slavery to the present. (Also listed as History 145, 146.) Two courses. *Gavins*

99. Dimension of Racism. The nature of racism, its interconnection with aspects and institutions of American life and effects. One course. *Staff*

100. Philosophy of Black Liberation. One course. *Olela*

113. African Philosophy. Religious and political philosophy of twentieth century Africa. One course. *Olela*

125. Religion and Theology of Black America. (Also listed as Religion 125.) One course. *Burford*

147. The Black in the City. (Also listed as Sociology 147.) One course.

150. Third World Literature. Selected works with special emphasis upon Black American, African, and Caribbean writers. One course. *Allen*

151. Classic Literature of Black America. Works by Black authors of the Negro renaissance followed by Wright's *Native Son* and Ellison's *Invisible Man*. One course. *Staff*

152. Contemporary Literature of Black America. Essays, poetry, and fiction by contemporary Black writers. One course. *Jackson*

176, 177. Marxism and Black Liberation. Marxist perspective on the liberation of Black America. Two courses. *Olela*

189. Special Topics. Spring 1973: Ethical Obligation and the Law. One course. *Olela*

191, 192. Independent Study. Two courses. *Staff*

193, 194. Independent Study in Community or Field Work. Two courses. *Staff*

195-196. Problems in Afro-American History. (Also listed as History 195V-196V.) Two courses. *Gavins*

209, 210. Afro-American History. Selected topics in Afro-American history from 1619 to present. (Also listed as History 209, 210.) Two courses. *Gavins*

THE MAJOR

1. Black Studies 99 and 100 required for major and strongly recommended as introductory to course work in Black studies.
2. Black History 83, 84 required.
3. Black Studies 193, 194 required. (It is suggested that the student seek his own community assignment and request approval.)
4. Three other courses above 100 to be selected with at least one being a seminar (one of which may include 193 or 194 but not both).

Students majoring in Black studies will receive special counselling in planning their course of study and considering future vocation.

Botany

Professor Wilbur, *Chairman;* Associate Professor White, *Director of Undergraduate Studies;* Professors Anderson, Billings, Culberson, Hellmers, Johnson, Kramer, Naylor, Philpott, and Stone; Associate Professors Antonovics, Boynton, Searles, and Strain; Assistant Professor Blankley; Lecturer C. F. Culberson

See *Biology* for listing of introductory courses.

53. Introductory Oceanography. Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one year of a laboratory science or concurrent enrollment in a laboratory science. This course does not satisfy a distributional requirement in the natural sciences. (Also listed as Geology 53.) One course. *Searles and Pilkey*

103. General Bacteriology. A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public health, soil fertility, and food preservation. Prerequisite: introductory biology. One course. *Johnson*

105. Plant Diversity. Major groups of the living plants, their evolutionary origins and phylogenetic relationships. Prerequisite: introductory biology. One course. *Culberson and White*

151. Introductory Plant Physiology. The principal physiological processes of plants, including water relations, mineral nutrition, synthesis and use of foods, and growth phenomena. Prerequisites: introductory college biology and one year of chemistry. One course. *Hellmers and Kramer*

152. Plant Identification. Practice in the identification of local plants and a study of the principles underlying plant classification. Laboratory, lectures, and field trips. One course. *Wilbur*

155. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or permission of instructor. One course. *White*

156. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisite: introductory biology. One course. *Billings and Strain*

167S. Ecology and Social Action. An introductory survey of the ecosystem and its problems; consideration of political and social solutions to them. (See Interdisciplinary Courses and Department of Political Science.) This course does not satisfy a distributional requirement in the natural sciences. One course. *Strain and Leach*

169. The Marine Environment. (For description see Marine Sciences.)

171. Marine Sciences Seminar. (For description see Marine Sciences.)

180. Principles of Genetics. Structure and properties of genes and chromosomes, and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Botany 280, Zoology 180, and Zoology 280.) With or without laboratory. One course. *Antonovics, Boynton, and Gillham (Zoology)*

186. Evolution. Analyses of the processes of adaptation and diversification of individuals, populations, and genetic systems. Prerequisites: introductory biology and genetics, or consent of instructors; cytology is recommended. (Also listed as Zoology 186, 286 and under the University Program in Genetics.) Not open to students who have had Zoology 109 or Botany 240. With or without laboratory. One course. *Antonovics and Lundberg (Zoology)*

191T, 192T, 193T, 194T. Independent Study. Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*

195S, 196S. Seminar in Botany. Credits to be arranged. *Staff*

203. Cytogenetics. Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. Laboratory optional, but limited to twelve students. One course. *Anderson*

209. Lichenology. Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. One course. *Culberson*

210. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. One course. *Anderson*

212. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. One course. *Searles*

221. Mycology. Field and laboratory study of vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in local flora. Prerequisite: one year of biological science. One course. *Johnson*

225ST, 226ST. Special Problems. Students with adequate training may do special work in the following fields:

1. Cytology; Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Lichenology. *Culberson*
7. Physiology. *Hellmers*
8. Bacteriology; Mycology. *Johnson*
9. Physiology. *Kramer*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics and Taxonomy of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

248. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, nucleic acids, and the metabolic interrelationships of these compounds. The biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction, and muscle contraction will also be considered. Prerequisites: organic chemistry (second semester may be concurrent), college mathematics, or permission of instructor; Chemistry 61 is recommended. (Also listed as Biochemistry 247 and Zoology 248.) One course. *Sage and Webster*

250. Plant Biosystematics. Basic descriptive and experimental procedures for the study of vascular plant evolution. Prerequisites: Botany 52 and 55 and either Botany 243 or a course in genetics, or their equivalents. One course. *Stone*

252. Plant Metabolism. The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. One course. *Naylor*

254. Plant-Water Relations. A study of factors affecting the availability of water, its absorption and use in plants, and the effects of water deficits on plant processes. Prerequisite: Botany 151 or equivalent. One course. *Kramer*

255. Plant Systematics. A study of the historical background of plant taxonomy, modern concepts and systems of classification, nomenclatural problems, and the taxonomy of specialized groups. Prerequisite: Botany 52 or equivalent. One course. *Stone and Wilbur*

257. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisite: Botany 156 or equivalent. One course. *Billings*

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. One course. *Naylor*

259. The Environment. Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 156 or equivalent. One course. *Billings*

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. One course. *Strain*

266. Analysis and Classification of Vegetation. The concepts and methods of synecology; modern approaches with a review of historical aspects. One course. *Strain*

285. Population Genetics and Evolution. A seminar and lecture course devoted to the analysis of the current literature in population genetics and evolution. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. One course. *Antonovics*

MARINE LABORATORY

Botany S211, Marine Phycology is offered annually at the Duke University Marine Laboratory, Beaufort, N.C.; Botany S205, Marine Microbiology is offered in alternate years. Consult the *Bulletin of the Marine Laboratory* for further information.

THE UNIVERSITY PROGRAM IN GENETICS

Genetics courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this *Bulletin* under *Genetics, the University Program* for description of the other offerings.

DEPARTMENTAL MAJOR

For the B.A. Degree

Prerequisites. Introductory biology or advanced placement in botany; Chemistry 1-2 or advanced placement in chemistry; one semester of college mathematics or equivalent.

Major Requirements. A minimum of five courses selected from the following: Botany 52 (Systematics), 55 (Anatomy), 105 (Morphology), 180 (Genetics), 151 (Physiology), 156 (Ecology). With approval of the Director of Undergraduate Studies, one or more of these courses may be taken in a related department.

Beyond these few basic courses a student's particular program will be tailored to his current interests and future plans.

For The B.S. Degree

Prerequisites. Introductory biology or advanced placement in botany; chemistry through organic chemistry; Mathematics 31, 32, or an equivalent year of college mathematics.

Major Requirements. A minimum of five courses selected from the following: Botany 52 (Systematics), 55 (Anatomy), 105 (Morphology), 180 (Genetics), 151 (Physiology), 156 (Ecology). With approval of the Director of Undergraduate Studies, one or more of these courses may be taken in a related department. One year of college physics, or equivalent, a course in statistics, and proficiency in two foreign languages are recommended.

The emphasis in this preprofessional program will depend on the student's particular interests. Specific programs will be arranged on an individual basis.

Interdepartmental Concentration

A student, while majoring in botany, may take course work in two or more scientific disciplines to such depths that requirements for the conventional major cannot be met. By joint consent of the appropriate departments, major-related interdepartmental programs may be pursued instead.

Chemistry

Professor Quin, *Chairman;* Associate Professor Wells, *Director of Undergraduate Studies;* Associate Professor Bonk, *Supervisor of Freshman Instruction;* Professors Bradsher, Brown, Chesnut, Hobbs, Jeffs, Krigbaum, Parham, Poirier, Smith, Strobel, and Wilder; Associate Professors McPhail and Palmer; Assistant Professors Baier, Baldwin, Crumbliss, Gutknecht, Henkens, Lochmüller, and Porter

1, 2. General Chemistry. For students not intending to pursue additional courses in chemistry. Students intending to take additional courses in chemistry must take Chemistry 11-12. Chemistry 1, consisting of three lectures and one discussion class per week, emphasizes the principles of chemistry; Chemistry 2 consisting of two lectures, one recitation, and one three hour laboratory per week emphasizes organic and biochemistry. Prerequisite: two years of high school mathematics. Chemistry 1 or its equivalent is a prerequisite for Chemistry 2. Two courses. *Staff*

11, 12. Principles of Chemistry. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Chemistry 11 emphasizes stoichiometry and atomic and molecular structure. Chemistry 12 emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Laboratory work includes both qualitative and quantitative analysis. Two lectures, one recitation and one four hour laboratory per week. Prerequisites: one year of high school chemistry, and qualification for Mathematics 31. Two courses. *Bonk and Staff*

101. Introductory Physical and Quantitative Chemistry. An intensive study of chemical equilibria with special attention to the physical chemistry of aqueous solutions, chemical kinetics, and elementary thermodynamics. Laboratory experiments illustrate the principles of analytical chemistry and instrumental analysis. One lecture, one recitation, and four and one-half laboratory hours. *Gutknecht, Lochmüller, McPhail, Poirier, and Wilder*

101P. Preceptorial. Elective preceptorial for students enrolled in Chemistry 101. *Staff*

117. Inorganic Chemistry. Bonding, structures, and reactions of inorganic compounds based on modern physical chemical concepts. Three lectures. Prerequisite: Chemistry 162 or the permission of the Director of Undergraduate Studies. One course. *Crumbliss, Palmer, and Wells*

131. Modern Chemical Analysis. Quantitative and instrumental techniques in analysis; selected topics in clinical analysis. Theoretical and applied aspects. Two lectures and four and one-half laboratory hours per week. Prerequisite: Chemistry 160 or 161. One course. *Gutknecht, Lochmüller, and Strobel*

132. Quantitative and Instrumental Analysis. Practice in advanced quantitative analysis and in the use of chemical instrumentation in analysis. A discussion of the theoretical and applied aspects of chemical and instrumental methods of analysis. Two lectures and four and one-half laboratory hours per week. Prerequisites: Chemistry 161, 162; Chemistry 162 may be taken concurrently. One course. *Gutknecht, Lochmüller, and Strobel*

151, 152. Organic Chemistry. An introduction to the study of the compounds of carbon in which the chemistry of both aliphatic and aromatic compounds is considered. Laboratory experiments are selected to illustrate the more important reactions and preparations of organic compounds. Three lectures and three laboratory hours. Prerequisite: Chemistry 61 or permission of Director of Undergraduate Studies; Chemistry 151 is prerequisite for 152. Two courses. *Staff*

152P. Preceptorial. Elective preceptorial for students in Chemistry 152. *Staff*

155. Qualitative Organic Analysis. Systematic identification of organic compounds based upon a study of physical and chemical properties. Infrared, ultraviolet, and NMR spectra are used in elucidation of structure. Two lectures ınd six laboratory hours per week. Prerequisite: Chemistry 152. One course. *Porter and Quin*

160. Elements of Theoretical Chemistry. A one semester course in the principles of physical chemistry. Credit is not given for both 160 and 161. Two lectures, one recitation, and three laboratory hours. Prerequisites: Chemistry 61, Physics 51-52, and Mathematics 32. One course. *Chesnut, Henkens, Hobbs, and Smith*

161, 162. Physical Chemistry. Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Two lectures, one recitation, and three laboratory hours. Prerequisites: Chemistry 61, Physics 51-52, and Mathematics 73. Two courses. *Hobbs, Krigbaum, and Smith*

191, 192. Independent Study. Supervised reading and research. Open to students by permission of the department. Two courses. *Staff*

193, 194. Independent Study. Supervised reading and research. Open to students who have completed Chemistry 191, 192, and by permission of the department. Two courses. *Staff*

195S. Seminar. Organic chemistry of pharmacological compounds. One course. *Staff*

196S. Physical Chemistry of Biological Macromolecules. Selected topics. One course. *Henkens*

201. Molecular Spectroscopy. Selected spectroscopic methods in the study of molecular structure. Topics include symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra, with examples drawn from both inorganic and organic chemistry. One course. *Staff*

203. Quantum Chemistry. Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundations of quantum theory. Emphasis on the application of molecular orbital theory to organic and inorganic systems. One course. *Staff*

205. Structure and Reaction Dynamics. Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Emphasis is on the use of kinetic techniques to solve problems in reaction mechanisms. One course. *Staff*

207. Principles of Thermodynamics, Diffraction, and Kinetics. Basic principles with applications to important chemical problems. One course. *Staff*

240. Chemical Oceanography. Physicochemical properties of seawater. Lectures, laboratory work, and field trips. Prerequisites: a year of analytical or physical chemistry, an introductory course in general or physical oceanography, or permission of the instructor. (Listed also as Zoology 240.) Given at Beaufort, summer 1973. Two courses. *Baier*

DEPARTMENTAL MAJOR

For the A.B. Degree

Prerequisites. Chemistry 11 and 12 or advanced placement; Mathematics 31, 32; Physics 51-52.

Major Requirements. Chemistry 101 or its equivalent, 131 or 132, 151, 152, 160 (or 161), and 195-196. Possible alternatives to 195-196 are:

1. Students may specifically request Chemistry 191-192, provided they pur sue an enriched program in the area of their proposed research. An enriched pro gram would include at least one chemistry course at the 200-level or Chemistry 15 or Chemistry 162. The permission of the proposed research director would b required.

2. Students who pursue their two courses of independent study or semina outside the department would be required to complete the major by taking on additional chemistry course at the 200-level, or Chemistry 155 or Chemistry 162

Recommended. Two semesters of a foreign language or the equivalent.

For the B.S. Degree

Prerequisites. Chemistry 11 and 12 or advanced placement; Mathematics 31 32, 73; Physics 51-52; two semesters of German or Russian or the equivalent

Major Requirements. Chemistry 101 or its equivalent, 131 or 132, 151, 152 155, 161, 162, 217, and 191-192. B.S. majors in interdisciplinary or double majo programs may elect independent study in one of their fields.

Recommended. Physics 161; Mathematics 51, 74, or 111.

Students planning graduate study in chemistry should complete one colleg year (or its equivalent) of a second language usually chosen from one of the abov or French and take additional courses in mathematics and physical sciences (se departmental adviser).

Classical Studies

Professor Oates, *Chairman;* Assistant Professor Rigsby, *Director of Undergraduat Studies;* Professors Newton, Richardson, and Willis; Associate Professor Stanley Assistant Professors Burian and Nixon

GREEK

1-2. Elementary Greek. A study of grammar and an introduction to reading Two courses. *Willis*

63-64. Intermediate Greek. Introduction to Greek prose and poetry. Firs semester: Plato's *Apology of Socrates* and two dialogues. Second semester: tw plays of Euripides. Two courses. *Truesdale*

87, 88. Sight Reading in Greek Prose. Readings from easy Attic prose writers. Open to students who have completed one year of college Greek, or th equivalent, with consent of the instructor. Two hours per week throughout the year. Two half-courses. *Truesdale*

95S. Seminar in Greek: Homer.* One course. *Stanley*

96S. Seminar in Greek: The Lyric Poets.* One course. *Stanley*

97S. Seminar in Greek: Tragedy. One course. *Burian*

98S. Seminar in Greek: Comedy. One course. *Burian*

99S. Seminar in Greek: The Historians.* One course. *Stanley*

100S. Seminar in Greek: The Orators.* One course. *Burian*

* Not offered in 1973–74.

117. Greek Prose Composition. The character of the course is determined y the needs of the students enrolled. Half-course. *Truesdale*

181S, 182S. Greek Seminar. An intensive introduction to the language and iterature. Meets five times a week. Open only to students who have achieved roficiency in another language. Two courses each. *Staff*

191, 192. Independent Study. Directed reading and research. Open only o highly qualified juniors and seniors. Two courses. *Staff*

198S, 199S. Senior Seminar in Greek. The seminar will change according o the interests of the instructor. Two courses. *Staff*

For Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by permission f instructor. One course. *Truesdale*

203. Homer. The *Iliad* and *Odyssey;* the problems of language and structure in the epic; present state of Homeric scholarship. One course. *Truesdale*

205. Greek Lyric Poets.* Fragments of the early lyric poets; selected odes f Pindar and Bacchylides. One course. *Truesdale*

206. Aeschylus.* The *Oresteia,* with study of the form of *Agamemnon* and ts place in the design of the trilogy. One course. *Willis*

208. Sophocles.* The Theban plays; the structure and style of Sophoclean ragedy. One course. *Willis*

209. Euripides.* Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. One course. *Stanley*

210. Aristophanes.* Origin and development of Greek comedy; representative plays of Aristophanes. One course. *Truesdale*

221. Early Greek Prose.* Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus; Gorgias, Antiphon, and the Old Oligarch. One course. *Willis*

222. Thucydides.* The *History;* Thucydides' historical method and style. One course. *Willis*

223. Greek Orators I.* Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. One course. *Staff*

224. Greek Orators II.* Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth-century political history and rhetorical development. One course. *Willis*

225. Plato.* Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. One course. *Stanley*

231. Hellenistic Poetry.* The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. One course. *Stanley*

* Not offered in 1973–74.

241. Advanced Prose Composition. Xenophon, Lysias, and other pros authors as models of style and practice in the writing of Attic prose. Half-cours *Willis*

LATIN

1-2. Elementary Latin. Study of the structure of the language (inflexions vocabulary, syntax, and pronunciation). Second semester: reading in prose an poetry. Two courses. *Staff*

63. Intermediate Latin. Selected prose. One course. *Stanley*

64. Intermediate Latin: Vergil. Readings from the *Aeneid;* lectures on th epic and its history and Vergil's style and technique. One course. *Stanley*

87, 88. Sight Reading in Classical, Mediaeval, and Renaissance Latin Offered especially for students in fields other than classical studies who wish t maintain and refresh their Latin. Two hours per week throughout the year. (Ope to students enrolled in other courses in Latin only on the recommendation of thei instructors.) Two half-courses. *Staff*

90. Not a course. This number represents one course credit for advance placement. One course of advanced placement will be awarded for scores of 4 o 5 on one or more of the College Board Advanced Placement tests in Latin. On course credit may be earned by a score of 3 if the student successfully completes one further semester of Latin.

95S. Seminar in Latin: Ovid.* One course. *Newton*

96S. Seminar in Latin: Lucretius.* One course. *Richardson*

97S. Seminar in Latin: The Lyric and Elegaic Poets.* One course *Richardson*

98S. Seminar in Latin: The Historians.* One course. *Staff*

99S. Seminar in Latin: Comedy. One course. *Richardson*

100S. Seminar in Latin: The Novel. One course. *Richardson*

117. Latin Prose Composition. The character of the course is determined by the needs of the students enrolled. Half-course. *Staff*

181S, 182S. Latin Seminar. An intensive introduction to the language and literature. Meets five times a week. Open only to students who have achieved proficiency in another language. Two courses each. *Staff*

191, 192. Independent Study. Directed reading and research. Open t highly qualified juniors and seniors. Two courses. *Staff*

193, 194. Independent Study for Graduation with Distinction. Tw courses. *Staff*

198S, 199S. Senior Seminar in Latin. The seminar will change according to the interests of the instructor. Two courses. *Staff*

* Not offered in 1973–74.

or Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by permission of structor. One course. *Newton*

201. The Verse Treatise.* The genre of didactic poetry; emphasis on Lucre-us' *De Rerum Natura,* Vergil's *Georgics,* and Ovid's *Ars Amatoria;* attention to icero's *Aratea,* the *Astronomica* of Manilius, Horace's *Ars Poetica,* and Ovid's *asti.* One course. *Richardson*

202. Roman Satire.* A survey of the genre, with concentration on Horace, venal, and Persius. One course. *Staff*

203. Epic: Vergil. The *Aeneid.* One course. *Staff*

204. Epic: Lucan and Statius. The development of the Roman epic in the lver Age. One course. *Staff*

207. The Prose Epistle.* The letter as a vehicle of communication and as literary form. One course. *Richardson*

208. The Epistle in Verse.* The verse letter as a literary form; reading the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. One Course. *Staff*

209. Fragments of Early Latin.* The remains of Latin poetry of the third nd second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on e epic and drama of Ennius. One course. *Stanley*

210. Lyric and Occasional Poetry.* Shorter verse forms: epigram, pas-ral, song, and panegyric. One course. *Staff*

211. Roman Oratory I.* The literary history and criticism of Roman ora-ry. One course. *Richardson*

212. Roman Oratory II.* A continuation of Latin 211. One course. *Staff*

221. Mediaeval Latin I. Latin literature of late antiquity, from Prudentius the Carolingian Revival. One course. *Newton*

222. Mediaeval Latin II.* Literature in Latin from Charlemagne to the enaissance. One course. *Newton*

241. Advanced Latin Composition. Experiments in imitation of the great atin prose styles and introduction to the composition of verse. Half-course. *ichardson*

LASSICAL STUDIES

51. Greek Literature in English Translation. Reading in translation of ajor Greek authors, with emphasis on the Homeric epic and the Attic drama. ne course. *Burian and Truesdale*

52. Latin Literature in English Translation. Reading in translation of najor Roman authors, such as Plautus, Terence, Vergil, Horace, Ovid, Petronius, uvenal, Tacitus, and Apuleius. One course. *Burian*

53. Greek History. The political and intellectual history of the Hellenes rom earliest times to the death of Alexander the Great. One course. *Nixon*

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* Not offered in 1973–74.

54. Roman History. The Roman republic and empire to the Council o Nicaea. One course. *Nixon*

55. Greek Art and Archaeology. Greek architecture, sculpture, and painting from the Bronze Age to the classical period. Study of objects in the Duke Classical Collection is included. One course. *Stanley*

56. Roman Art and Archaeology. Rome's achievement in architecture an decoration, portraiture, and relief sculpture; from the Villanovans to the Antonin emperors. One course. *Stanley*

57S, 58S. Seminar in Classical Studies. Aspects of the history, art, an literature of classical Greece and Rome. For freshmen and sophomores. Tw courses. *Rigsby*

113. Ancient Historians and Historiography.* Theory and practice o Herodotus, Thucydides, Polybius, Livy, Sallust, Tacitus, and Ammianus Marcellinus. One course.

114. Greek Drama. Reading in English translation of Aeschylus, Sophocles, Euripides, Aristophanes, and Menander. (Not open to students who hav taken Classical Studies 51.) One course. *Truesdale*

115. The Classical Tradition. The notion of the "classical" from the creation of the archetype to the present. One course. *Burian*

116. Criticism of the Arts and Letters in Antiquity.*Aesthetic theory an practical criticism among the Greeks and Romans. One course.

117. Ancient Mythographers. Myth in classical and mediaeval writer from Hesiod to Boccaccio. One course. *Newton*

134. The Athenian Empire.* Imperial democracy at Athens and its consequences for the *polis*. One course. *Staff*

135. Alexander the Great.* His career and the effects of his conquests. One course. *Staff*

136. The Hellenistic Kingdoms.* The Greek world from the death o Alexander in 323 B.C. to the end of the second century B.C. One course.

137. The Roman Revolution. Rome from the time of the Gracchi (133 B.C.) to the death of Augustus (14 A.D.). One course. *Rigsby*

138. The Decline and Fall of Rome. Rome from the death of Commodus to the accession of Constantine. One course. *Rigsby*

143. The Ancient Cities of Greece. The *polis* as a physical and societa complex; urban problems and their solutions through the centuries. A differen Greek city that has been extensively excavated and well published is chosen a representative of each century and examined in detail. One course. *Richardso*

144. Ancient Cities: Rome and Her Colonies. As a metropolis and a cosmopolis; the sources and uses of significant architectural and urbanistic ideas; the city government and organization of the megalopolis; Roman colonies throughout the Empire. One course. *Richardson*

* Not offered in 1973–74.

191, 192. Independent Study. Directed reading and research. Open only o highly qualified juniors and seniors. Two courses. *Staff*

195S, 196S. Junior Seminar in Classical Studies. The seminar will hange each year according to the interest of the instructor. Two courses. *Nixon*

or Seniors and Graduates

231. Greek Sculpture.* Techniques and style of the major schools and ersonalities in archaic, classical, and Hellenistic free-standing and architectural culpture. One course. *Stanley*

232. Greek Painting. Techniques and style in the various media; emphasis n the problems of chronology, attribution, and iconography of Attic pottery. One ourse. *Stanley*

235. Roman Architecture.* Significant monuments chosen to exemplify he Roman genius in building in the late Republic and early empire. One course. *ichardson*

236. Roman Painting.* Roman pictorial art with concentration on the wall-ainting from Campania. Investigation of techniques, iconography, and the use f pictures in decoration. One course. *Richardson*

253. Greece to the Orientalizing Period.* One course. *Oates*

254. The Age of the Tyrants and the Persian Wars* One course. *Oates*

255. The Age of Pericles.* One course. *Oates*

256. The Fourth Century through Alexander.* One course. *Oates*

260. The History of Rome to 164 B.C.* One course.

261. The Roman Revolution, 146-30 B.C.* One course. *Oates*

262. Rome under the Julio-Claudians. One course. *Staff*

263. From the Flavian Dynasty to the Severan.* One course. *Nixon*

264. From Septimius Severus to Constantine.* One course. *Nixon*

270. The Rise of the Hellenistic Kingdoms.* One course. *Oates*

271. The Hellenistic World, 250-31 B.C.* One course. *Oates*

EPARTMENTAL MAJOR IN GREEK

Prerequisite. Greek 2 or equivalent.

Major Requirements. Six courses in Greek above the level of Greek 2. In ad-ition, students will be required to pass an examination testing proficiency in reek composition or to complete Greek 117.

Related Work. Greek majors normally take at least four semesters of Latin, nd are also encouraged to take course work in ancient history and/or archaeology. he nature and amount of related work, however, may vary with the student.

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* Not offered in 1973–74.

DEPARTMENTAL MAJOR IN LATIN

Prerequisite. Latin 64 or equivalent.

Major Requirements. Six courses in Latin above the level of Latin 64. In addition, students will be required to pass an examination testing proficiency in Latin composition or to complete Latin 117.

Related Work. Latin majors normally take at least four semesters of Greek and are also encouraged to take course work in ancient history and/or archaeology The nature and amount of related work, however, may vary with the student.

DEPARTMENTAL MAJOR IN CLASSICAL STUDIES (ANCIENT HISTORY AND ARCHAEOLOGY)

Prerequisite. Classical Studies 53-54 or 55-56.

Major Requirements. Eight courses at the 100-level or above, including two courses of seminar or independent study, or a combination of these. Reading knowledge of Latin or Greek to the level of Latin 64 or Greek 64. Two courses in the ancient languages above that level may be counted toward the major.

Majors in either Greek or Latin who contemplate graduate work are reminded of the necessity for competence in both languages for all higher degrees and of the requirement for a reading knowledge of French and German (usually an examination in one of these languages must be passed in the first year of graduate work and an examination in the other the second year).

Majors are eligible for nomination to a term of one semester during their junior year at the Intercollegiate Center for Classical Studies in Rome, of which Duke University is a founding member, at a cost comparable to that of a semester at Duke. Financial arrangements are made through the University, and students may apply for scholarship assistance. Courses in Greek, Latin, ancient history, and archaeology taken at the Center are counted toward the degree requirements of the Department of Classical Studies. For further information, see section on study abroad.

The department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

Comparative Area Studies: Africa, Asia, Latin America

Professor Silberman (History), *Director;* Professors Bronfenbrenner (Economics) and TePaske (History); Associate Professors Di Bona (Education) and Johns (Political Science); Assistant Professors Bergquist (History), Hartwig (History), O'Barr (Anthropology); Instructors Dirlik (History), Mook (Political Science), and Valenzuela (Political Science)

The aim of the comparative area studies major is to introduce the student to the problems of contemporary societies outside of Western Europe and the United States through a study of interactions between traditional features of the societies and the forces of social and political change. Special attention is given to institutional characteristics of the different societies. The great diversity of traditional institutions in the different societies that form the basis for the major provides opportunities for examination of the intellectual, political, economic, religious, and social movements primarily in the areas of Africa, Asia, and Latin America. The major is under the supervision of a committee consisting of faculty members from departments with relevant area interests.

THE MAJOR

The student must identify both his disciplinary interest and his geographic area of interest. This will normally be done by the end of the sophomore year, but if fulfillment of requirements is possible, it may be done at a later stage. Because of the complexity of the program, students should consult the Director before declaring a major.

A special feature of the major is provision for the granting of credit to qualified students who wish to study abroad in the area of choice or who wish to undertake intensive summer language programs in the United States.

For a description of the courses which are listed below, consult the listings under the specified department.

Prerequisites. Any two of the following courses: History 61, 62; Political Science 155; Anthropology 94; Religion 57. Four semester courses of one language, or two semester courses of one language followed by two semester courses in the literature of the area in translation or two semester courses in general linguistics. Students identifying Africa as their area of interest may offer a relevant European language (other than English) in place of an African language. The language-literature prerequisite need not be completed before declaration of the major.

Major Requirements. Four semester courses in the geographic area of interest (the area of the language studied). Two semester courses in a second geographic area included in the major; senior seminar in comparative area studies.

The following are courses currently available for the fulfillment of the major prerequisites and requirements:

Language and Literature

Hindi-Urdu 171, 172, 181, 182, 183, 184, 185, 186, 200-201.
Chinese 131, 132, 133, 134, 135, 136.
Japanese 131, 132, 133, 134, 135, 136.
Swahili 101, 102.
Spanish 1-2, 63, 64, 155, 156, 255, 256.
Portugese 181, 182, 185, 186.
Black Studies 113, 151, 189.
English 107.
Anthropology 238, 240, 260, 261.

Area Courses

(Courses focusing mainly on one of the geographic areas of the major. Other courses may be added at the discretion of the Director.)
Anthropology 125, 128, 220, 222, 240, 260.
Art 150, 241.
Economics 109, 114, 120, 219. 286S.
Education 202, 218, 219.
History 101, 102, 115, 116, 119, 120, 131, 132, 141, 142, 143, 147, 148, 155, 156, 211, 231-232, 233-234, 247, 248, 261-262, 265-266, 287-288, 195G-196G, 195K-196K, 195S-196S, 195W-196W, 195X-196X, 195Y-196Y.
Music 173.
Political Science 124, 151, 155, 180, 181, 182, 250, 280.
Religion 57, 140, 141, 143, 149, 183, 217, 218, 284, 285, 289.
Sociology 136, 251.

Comparative Literature

Professor Salinger (German), *Chairman of the Committee on Comparative Literature;* Professors Anderson (English), Fowlie (Romance Languages), Lievsay

(English), Newton (Classical Studies), Reardon (English), Reiss (English) Wardropper (Romance Languages); Associate Professors Clubbe (English), Harwell (English), Jezierski (Slavic Languages and Literatures), Krynski (Slavic Languages and Literatures); Assistant Professor Burian (Classical Studies); Lecturer Shonek (Hindi-Urdu)

100. Introduction to Comparative Literature. History, prevailing approaches, methods of investigation, problems of literary influence and translation European and American movements and genres. Occasional guest lecturers. One course. *Staff*

112. English Literature of the Middle Ages. (Also listed as English 112.) One course. *Reiss*

115. The Classical Tradition. (Also listed as Classical Studies 115.) One course. *Burian*

117. Ancient Mythographers. (Also listed as Classical Studies 117.) One course. *Newton*

151. Theory and Form of Tragedy. One course. *Fowlie*

161. The European Background of English Literature. (Also listed as English 161.) One course. *Harwell*

163, 164. Readings in European Literature. (Also listed as English 163, 164.) Two courses. *Clubbe*

165. Readings in Scandinavian Literature. (Also listed as English 165.) One course. *Anderson*

169. Modern European Drama. (Also listed as English 169.) One course, *Reardon*

171, 172. Studies in Indian Literatures. (Also listed as Hindi-Urdu 171, 172.) Two courses. *Shonek*

186. Non-Russian Slavic Literatures. (Also listed as Slavic Languages and Literatures 186.) One course. *Jezierski*

191, 192. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission. Two courses. *Salinger*

193, 194. Independent Study. Directed readings and research. Open only to qualified students in the senior year, by permission. Two courses. *Salinger*

201, 202. Romanticism. Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany, with some reference to other countries. Selected subjects will occasionally be covered by speakers from various departments of the University. Two courses. *Salinger*

203, 204. Realism and Symbolism. Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. Two courses: *Salinger*

205. Foundations of Twentieth Century European Literature. The roots f the contemporary scene (Proust, Mann, Rilke, Kafka, Lorca, Lagerkvist, Gide, amus, Hesse) evolving toward a mythology of man. One course. *Salinger*

213, 214. The Slavs: Literature and Culture. (Also listed as Slavic Lanuages and Literatures 213, 214.) Two courses. *Krynski*

285. Literary Criticism. (Also listed as English 285.) One course. *Lievsay*

AJOR IN COMPARATIVE LITERATURE

Prerequisite. A reading knowledge of at least one foreign language; English 5, 56 or the equivalent.

Major Requirements. (1) Reading knowledge of a second foreign language; 2) three courses in a single foreign literature, to be read in the original (comittee approval required); (3) Comparative Literature 100 and two other comarative literature courses, at least one of which must be a 200-level course.

The Committee on Comparative Literature will assist the major in creating a rogram having unity and direction. The committee will also advise the student of ertinent conference courses and seminars offered each year in the various literare departments. Inquiries may be directed to the Chairman of the Committee on omparative Literature, Professor Salinger, 106 Languages Building.

omputer Science

ssociate Professor Patrick, *Acting Chairman;* Assistant Professor Ramm, *Director f Undergraduate Studies;* Professors Gallie, Marinos, Naylor, Nolte, and Woodury; Associate Professors Hammond and Starmer; Instructors Austin and cAnulty; Adjunct Associate Professor Williams

The Department of Computer Science provides courses on the theory of omputer design, capabilities, and use. Most courses require the student to make xtensive use of one or more of the available computers as a problem-solving nstrument.

Students who wish to take a single introductory course in computer science, s part of their general education, normally elect Computer Science 51.

42. Introduction to Digital Systems. (For description, see Electrical Engieering 42.) One course. *Marinos*

51. Introduction to Digital Computation. Flow charts; an assembly lanuage; program structures, subroutines, data structures, arrays, polynomials; an lgorithmic language; numerical linear algebra, matrix inversion, linear programing, and least-squares techniques. (Also listed as Mathematics 51.) One course. *allie and Staff*

150. Computers and Programming. Computer structure, machine language, nstruction execution, addressing techniques, and digital representation of data. omputer systems organization, logic design, micro-programming, and interpreters. ymbolic coding and assembly systems, macro definition and generation, and rogram segmentation and linkage. Prerequisite: Computer Science 51. One course. *taff*

150P. Preceptorial. Elective preceptorial for students enrolled in Computer cience 150. *Staff*

152. List Processing and Data Structures. Linear lists such as stack queues, deques, circular lists, and doubly linked lists; trees; multilinked structure dynamic storage allocation. Exercises will require use of an assembly languag Prerequisites: Computer Science 51 and 150. (Also listed as Mathematics 152 One course. *Staff*

152P. Preceptorial. Elective preceptorial for students enrolled in Comput Science 152. *Staff*

157. Introduction to Switching Theory. (For description, see Electric Engineering 157.) One course. *Marinos*

161. Numerical Solution of Ordinary Differential Equations. (For d scription, see Mathematics 161.) One course. *Murray*

163. Data Analysis. Elements of probability and statistics, acquisition data, maintenance of data bases, computation and display of statistical summarie Prerequisites: Computer Science 51 and Mathematics 31 or equivalent. One cours *Woodbury*

191, 192. Independent Study. Directed reading and research for qualifie juniors. Prerequisite: permission of instructor and Director of Undergradua Studies. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for qualifie seniors. Prerequisite: permission of the instructor and Director of Undergradua Studies. Two courses. *Staff*

For Seniors and Graduates

203. Random Signals and Noise. (For description, see Electrical Eng neering 203.) One course. *Kerr and Nolte*

205. Signal Detection and Extraction Theory. (For description, see Elec trical Engineering 205.) One course. *Nolte*

208. Digital Computer Design. (For description, see Electrical Engineerin 208.) One course. *Marinos and Owen*

210. Image Processing. Digital image transducers and processing algo rithms; special purpose filters and tracking algorithms as applied to both binar and multi-gray level images; transducer hardware such as flying spot scanners an image dissectors. One course. *Starmer and Fortney*

211. Control Programs in Operating Systems. Review of control program such as task scheduling, memory allocations, and I/O control. Identification of th common features of control programs and the hardware-software tradeoffs require for implementation. Prerequisite: Computer Science 231. One course. *Austin an Starmer*

212. Advanced Topics in Control Programs. Resource allocation; simula tion of various algorithms to identify constraints in a hypothetical system. Pre requisites: Computer Science 231 and 211. One course. *Austin and Starmer*

215. Artificial Intelligence. Heuristic versus algorithmic methods; pro gramming of games such as chess; theorem proving and its relation to correctnes of programs; readings in simulation of cognitive processes, problem-solving, seman c memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or ermission of the instructor. One course. *Austin*

221. Numerical Analysis I. Error analysis and interval arithmetic, interolation and polynomial approximation methods, numerical differentiations and ıtegration, solution of simultaneous linear equations and matrix inversion, real nd complex roots of non-linear equations. Prerequisite: knowledge of an algoithmic programming language and intermediate calculus. (Also listed as Matheıatics 221.) One course. *Patrick*

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, umerical methods for solving ordinary differential equations, partial differential quations, and integral equations. Prerequisite: Computer Science 221 or quivalent. (Also listed as Mathematics 222.) One course. *Patrick*

223. Numerical Analysis III. Rational approximation methods, spline aproximations, optimization techniques, global methods for solving non-linear algeraic equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as lathematics 223.) One course. *Patrick*

231. Introduction to Operating Systems. Characteristics and components f operating systems and methods for their implementation. Program linkage and elocation, job scheduling, resource allocation and interrupt handling, input/output ontrol systems, on-line file structures, communication, time sharing and real time ystems. Case studies of existing systems. Prerequisite: Computer Science 150 or 52. One course. *Austin and Starmer*

232. Metaprograms. Programs which process programs: compilers, interreters, and assemblers. Syntax and semantics of programming languages. One ourse. *Gallie*

241, 242. Information Organization and Retrieval. This course deals with ıe structure, analysis, organization, storage, searching, and retrieval of information. tudied in particular will be structure of files, dictionary construction and look-up, earch and matching procedures, indexing, file maintenance and methods for user ıteraction with the automated system. Practical programming experience in such echniques will be included. Prerequisite: Computer Science 51, 152. Two courses. *lammond*

244. Econometrics II. (For a description, see Economics 244.) One course. *'aylor*

250. Clustering and Classification. Algorithms and operating characteristics of clustering and classification methods. Data models for sequential data acuisition, clustering in terms of nearest neighbor and/or mixtures of distributions missing information principle). Characterization of patient groups versus normal roups and selection of measures to characterize diseases as super-clusters. Application of Bayes' procedures to classification into clusters and super-clusters. Preequisite: permission of the instructor. One course. *Woodbury*

265. Advanced Topics in Computer Science. Opportunity for study of dvanced problems in computer science, possibly leading to the development of a ubstantial computer program. One course. *Staff*

DEPARTMENTAL MAJOR

The B.S. Degree

Prerequisites. Computer Science 51; Mathematics 31, 32, 101, 102.

Major Requirements. Computer Science 150, 152, three of the following 157, 163, 215, 221, 231, 232, 241; and one more course in Mathematics at th 100-level or above. The student must take enough additional courses so that h has completed at least five courses (excluding Mathematics 101, 102) at the 10 level or above in one department other than computer science.

Students planning to do graduate work will probably find a reading know edge of at least one foreign language useful. Students who expect to do thei graduate work in computer science should try to include Computer Science 22 and modern algebra in their course of study.

Economics

Professor Davies, *Chairman,* Assistant Professor Black, *Director of Undergradua Studies;* Professors Blackburn, Bronfenbrenner, de Vyver, Goodwin, Kelley, Krep Naylor, Saville, Treml, Vernon, and Yohe; Associate Professors Grabowsk Havrilesky, and Weintraub; Assistant Professors de Marchi, Graham, McElro and Salkin

Economics courses aim to develop in the student the critical and analytic skills essential for understanding economic problems and institutions, in both the contemporary and in their historical setting. Although no particular vocational c professional goal is emphasized, these courses provide the academic backgroun necessary for positions in industry, for work in many branches of government serv ice, and for graduate study in economics and the social sciences.

Economics 1 or 51 and 2 or 52 are recommended to all students planning t elect further courses in the department.

Students planning to do graduate work in economics are advised to take many of the following courses in mathematics (listed in preferential order) as the schedules permit: Mathematics 31, 32, 51, 73, 74, 131, and 135-136.

1. National Income and Public Policy. Basic economic analysis emphasi ing current public policy issues. How the level and rate of growth of aggregat national income and output are determined. What causes unemployment, inflatio and international payments problems. How monetary policy (money supply an interest rates) and fiscal policy (government expenditures and taxes) affect thes problems. Economic problems of developing countries. (Open only to freshmen. One course. *Staff*

2. Competition, Monopoly, and Welfare. A continuation of Economics How the composition of the economy's output and the distribution of its incom (who is rich and who is poor) are determined in a market economy by supply an demand. How and why markets work or fail to work and the implications for soci policies. Role of government in a market economy: topics such as environment economics, monopoly, unionism, international trade. Comparison of a mark economy with other systems of economic organization. (Open only to freshme and not open to students who have had Management Sciences 50.) One cours *Staff*

51. National Income and Public Policy. Introductory course similar to conomics 1, but at a slightly more advanced level. (For sophomores, juniors, and eniors.) One course. *Staff*

52. Competition, Monopoly, and Welfare. Similar to Economics 2, but at slightly more advanced level. (For sophomores, juniors, and seniors and not open students who have had Management Sciences 50.) One course. *Staff*

51D, 52D. The same courses as Economics 51, 52 except taught as lectures ith small group discussion sections. Two courses.

53. Economics of Contemporary Issues. Topics such as environmental uality and "free" resources, crime, exploitation, and discrimination (racial and exual), the ghetto, wage and price controls, education, athletics, and the welfare-arfare state. Prerequisites: Economics 51 and 52. One course. *Havrilesky*

106. The Economics of Poverty. Poverty in the United States: its defini-ion, measurement, history, racial dimensions, and present and proposed policies or its amelioration. Prerequisite: Economics 52. One course. *Blackburn and reps*

108S. Economics of War. Conflict theory, causes and economic con-equences of war, military manpower, military-industrial complex, disarmament nd the economy. Prerequisite: Economics 52. One course. *Staff*

114. Economic Geography of Africa. A continental study of the natural nvironmental factors of Africa and the basic economic patterns of adjustments nd adaptations on regional or national bases. One course. *Tuthill*

115. Fundamentals of Geography. A functional social studies approach to eographic factors and their interrelationships. One course. *Tuthill*

116S. Economic Geography of Anglo-America. Geographic and economic egions of the United States and Canada; their resource base and the major econom-c activities, their spatial distribution and relative significance. One course. *Tuthill*

120. Economic Geography of Asia. Concepts of agricultural, manufactur-ng, and distributive location theory, resource evaluation, and regional planning in sia. One course. *Tuthill*

132. Development of the American Economy. From first settlement to resent: quantity of goods and quality of life; employment and leisure; domestic nd foreign commerce; poverty and affluence; money and prices; slavery, agricul-ure, and ghettos; business and labor; and roles and policies of governments. One ourse. *Saville*

134. Quantitative Analysis in Economics. Mathematical techniques of im-ortance in economics. Partial derivatives, Lagrange multiplier methods, matrix heory, and difference and differential equations. Prerequisite: Mathematics 21 or 1. One course. *Staff*

138. Economic Statistics. Survey of principal concepts and methods ap-lication to economics. (Not open to students who have had Mathematics 133, Management Sciences 60, Psychology 117.) One course. *McElroy*

139. Introduction to Econometrics. Data collection, estimation, and ypothesis testing. Use of econometric models for analysis and policy. Prerequisites:

Math 31 and 32, or equivalent, and Economics 138 or Management Sciences 6 or equivalent. One course. *McElroy and Vernon*

149. Microeconomic Theory. Cost and supply considerations in pric theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open t students who have had Economics 161.) *Black, Graham, Treml, and Vernon*

150. History of Economic Thought. Includes approaches to economic problems from Aristotle to Samuelson, emphasizing certain models and doctrines—thei origins, relevancy, and evolution. Readings from Mun, Quesnay, Adam Smitl Malthus, Ricardo, Marx, Pareto, and Keynes. One course. *de Marchi an Goodwin*

153. Money and Banking. The lender's side of financial markets. Th activities of commercial banks and other financial institutions in supplying loanabl funds and the effects of these activities on the money supply and its rate of use the impact of central bank and Treasury operations on financial markets, and th evolution of the present monetary system and its institutions. One course. *Yoh and Havrilesky*

154. Aggregative Economics. Concepts and measurement of national income and expenditures, employment, and price levels; the theoretical determinatio of these aggregates; and applications of macroeconomic theory to business cycle and economic growth. One course. *Black, Bronfenbrenner, and Havrilesky*

155. Labor Problems. An examination of present-day labor problem followed by an intensive study of methods used by employers and workers in meeting those problems. One course. *de Vyver and Kreps*

161. Economic Analysis for Public Policymaking: Microeconomic anc Non-Probabilistic Models. Survey and application of analytical tools required fo understanding public policy problems. Not open to students who have had Economics 149. (Also listed as Public Policy Studies 110). One course. *Graham*

166S, 167S-168S. Environmental Policy. Analysis and evaluation of th policy problems and conflicts which result from human interaction with the environment. Three sequential courses, spring, summer (including internship), and fall, respectively. Permission of instructors required. (One term semester credit towarc the major in economics will be given for completion of all three term courses.) *Staff*

176S, 177S-178S. Health Policy. Analysis of health care problems anc policies. Three sequential courses, spring, summer (including internship), and fall respectively. (One term semester credit toward the major in economics will be given for completion of all three term courses.) *Staff*

189. Business and Government. Public policies which most directly affect the operation of competition in the business world. The economic basis for and evaluation of antitrust policy, public utility regulation, and public enterprise. Prerequisite: Economics 149 or consent of instructor. One course. *Grabowski an Vernon*

191, 192. Independent Study. Directed reading and research. Admission will be subject to approval of the individual instructor and the department. Two courses. *Staff*

193, 194. Independent Study. Same as Economics 191, 192 but for seniors. wo courses. *Staff*

195. Man-Computer Policy Games. Experience in playing, administering, nd evaluating policy games such as tax policy, managerial decision-making in com-etitive markets, and policy toward family planning. One course. *Naylor*

198S. Topics in Market Organization. Market structures, related economic nd legal issues, and attempted policy solutions in the United States. Prerequisite: conomics 149. One course. *Grabowski and Vernon*

199. The Changing South. (Also listed as Interdisciplinary Course 199.)

200. Capitalism and Socialism. Selected ideological classics of new and ld right and left economics including both "counsels for perfection" (Utopias) and precepts for action" in political economy. Prerequisites: Economics 51 and 52, and ermission of instructor. One course. *Bronfenbrenner*

201S, 202S. Senior Seminar in Economics. Problems in theory and ap-lied economics. Readings, reports, and discussion of selected topics. For majors n economics, with consent of the department. Two courses. *Staff*

204S. Advanced Money and Banking. Monetary theory and its statistical nd institutional implementation. Particular attention is given to the development f aggregative theories of prices, interest rates, and production; the functioning of onetary policy within various theoretical frameworks; and appraisal of the re-ent use in the limitations of Federal Reserve policy. One course. *Havrilesky and ohe*

211. Introduction to Mathematical Economics. Applications of topics in alculus, differential equations, and linear algebra to the theory of the firm, capital heory, macroeconomics, cycles, growth, and linear economic models. Prerequisites: conomics 149 and 154 and Math 31 and 32, or equivalent. One course. *Graham*

214. Geonomics: Geography and Contemporary Economics of Africa. nvironmental factors in relationship to major economic activities, emphasizing he resource base, ecological adjustments, landscape morphology, and international nterdependence. A series of national studies synthesized into a continental format. rerequisite: permission of the instructor. One course. *Tuthill*

219. Economic Problems of Underdeveloped Areas. Consideration and nalysis of the economic and related problems of underdeveloped countries. Some ttention will be given to national and international programs designed to accele-ate the solution of these problems. One course. *Kelley and Naylor*

231. Economic Development of Europe. Sequence of local, national, and nternational economic structures under situations of changing trade, industry, griculture, population, investment, war conditions, public ownership, cartels, olonialism, and prices. One course. *Saville*

233. State and Urban Finance. Fiscal problems of state and local govern-ent. Expenditures, taxation, and debt; intergovernmental financial relations. rerequisite: Economics 51-52 or consent of instructor. One course. *Black and avies*

234. Urban Economics. Economic factors which influence the internal evelopment of metropolitan areas. Urban problems involving slums, ghettos, poverty, and transportation are analyzed from an economic point of view. Prerequisite: Economics 149 or consent of instructor. One course. *Black*

237, 238. Statistical Methods. A study of statistical methods appropriat for dealing with problems in business and social science. In addition to developing more thoroughly the subject considered in Business Statistics, the followin methods will be considered: simple, multiple, partial, and curvilinear correlatior curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of the instructor. Two courses. *Staff*

243. Econometrics I. Economic theory, mathematics, statistical inferenc and electronic computers applied to analysis of economic phenomena. Objectiv is to give empirical content to economic theory. Matrix algebra used to develo topics in inference, linear regression, and systems of simultaneous equations. Us is made of the electronic computer. One course. *Naylor*

244. Econometrics II. A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design (Also listed as Computer Science 244.) One course. *Naylor*

245. Econometrics III. Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making simultaneous equation methods, and forecasting. Emphasis on current applie literature. A Track 1, third-level course (see heading, Statistics). Prerequisite Economics 243. One course. *McElroy*

249. Theories of Economic Behavior. Relationship between property rights and economic behavior; influence of information and transaction costs on economic institutions and market behavior; capital budgeting and the theory of investment under uncertainty; role of government; elements of fiscal and monetary theory. Primarily for non-majors. Prerequisites: Economics 51-52. One course *Staff*

257. Manpower and Human Resources. Allocation of human resources returns to investments in education and training; qualitative composition of the labor force. One course. *Kreps*

262. Trade Unionism and Collective Bargaining. An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. One course. *de Vyver*

265S. International Trade and Finance. A study of fundamental principles of international economic relations. Subjects covered include the economic basis for international specialization and trade, and the economic gains from trade, the balance of international payments, problems of international finance, investments, and monetary problems. Prerequisite: Economics 149. One course. *de Marchi*

287. Public Finance. An analysis of the impact of governmental expenditures, revenues, and debt on the allocation of resources, the redistribution of income, and the stabilization of income. One course. *Black and Davies*

293. Soviet Economic History. Economic policy-making in the USSR in a historical setting. One course. *Treml*

294. Soviet Economic System. Theoretical problems of resource allocaon, economic development, and optimal micro-decision-making in a non-market conomy. One course. *Treml*

EPARTMENTAL MAJOR

Prerequisites. Mathematics 31, Economics 1 or 51, Economics 2 or 52 Management Sciences 50 will be accepted in lieu of Economics 2 or 52).

Major Requirements. Any five additional courses in the department. Subitution of courses in other departments for similar courses in the Economics Deartment will not be permitted, with one exception, which is that Mathematics 133 r Management Sciences 60, if taken prior to spring semester 1971-72, may be subituted for Economics 138, thereby counting toward the five-course requirement. One term semester credit toward the major will be given for completion of each of he following three course series: Economics 166S, 167S-168S and Economics 76S, 177S-178S.

The department offers work leading to graduation with distinction. See the ection on Honors in this *Bulletin.*

Education

Professor Hurlburt, *Chairman;* Associate Professor Sublett, *Director of Underraduate Studies;* Professors Cartwright, Gehman, Githens, Hopkins, Petty, Shuman, and Weitz; Associate Professors Adams, Ballantyne, Carbone, Colver, Davis, Di Bona, Flowers, Johnson, Katzenmeyer, Martin, and Pittillo; Part-time Instructor Troy

Students who expect to teach in the public schools should plan their courses n accordance with the general regulations set forth under Teaching. Students who intend to teach in elementary schools should consult with Professors Petty or Sublett; those intending to teach in secondary schools should consult with Professors Cartwright, Githens, Johnson, or Shuman. Students should confer with these advisers prior to registration each semester.

Students who do not expect to teach but desire an understanding of the chool as part of a liberal education are advised to elect such courses as Educaion 100 and 113 for their introductory work in the department and then to elect urther work in accordance with their special interests.

100. Social and Philosophical Foundations of Education. A study of the basic features, assumptions, viewpoints, and issues of education in contemporary America. This course or Education 113 is required of all who intend to practice teach and of all majors in education, and should be taken in the junior year. One course. *Carbone, Di Bona, Johnson, Martin, and Sublett*

105. Elementary Education: Reading. Must be taken concurrently with Education 106. Half-course. *Adams*

106. Elementary Education: Language Arts. Must be taken concurrently with Education 105. Half-course. *Adams*

107. Elementary Education: Arithmetic. The processes, methods, and materials basic to the teaching of arithmetic in the elementary schools. Required in the elementary-education major. Half-course. *Petty*

108. Elementary Education: Science. The principles, methods, and materials basic to the teaching of the sciences in the elementary school. Required i the elementary-education major. Half-course. *Githens*

113. History of American Education. A study of American education fron colonial times to the present. The development of schools, their organizations, administration, curriculum, and methods as seen in relation to the social forces tha have produced our particular type of civilization. One course. *Johnson*

118. Educational Psychology. Psychology of learning, individual and socia development, and psychology of adjustment as related to problems of instructio and the process of education. Prerequisite: Psychology 92, 93, 94, or 95. On course. *Davis*

151. Public School Music Education. Required in the elementary-education major. (See Music Education 151 for description.) Half-course.

152. Public School Music Literature. Required in the elementary-education major. (See Music Education 152 for description.) Half-course.

153. Vocal Music in the Public School. (See Music Education 153 fo description.) One course.

154. Instrumental Music in the Public School. (See Music Education 15 for description.) One course.

161. Integrated Art in the Public School. Work in the materials and methods in basic two-dimensional art media. Half-course. *Stars*

162. Plastic Art in the Public School. Work in basic three-dimensiona art; emphasis on ceramics. Half-course. *Stars*

169. Contemporary Issues in Education: Minorities and the Schools Issues and problems concerning minorities, particularly Blacks, in relation to th school. One course. *Staff (Coordinator, Di Bona)*

191, 192. Independent Study. Directed reading and research for juniors. Prerequisite: approval of instructor and the Director of Undergraduate Studies Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for seniors Prerequisite: approval of instructor and the Director of Undergraduate Studies Two courses. *Staff*

195S. Elementary Education: Principles. The nature, subject matter, and organization of elementary education for instruction in the primary and intermediate grades. Must be accompanied by Education 196. Half-course. *Petty an Sublett*

196. Elementary Education: Internship. Full-time observation and teaching for half a semester. Prerequisites: Education 195S, *C* average overall and in the elementary education major; preparation for teaching in the elementary school; o consent of the instructor. This course combined with Education 195S will fulfill the seminar and independent study requirement. One and one-half courses. *Petty and Sublett*

201. Teaching and Supervision of Arithmetic. Special attention is given to the number system, the fundamental operations (with whole numbers, fractions, and decimals), percentage, and measurements. Considered also are the meaning heory, methods of teaching, problem-solving, evaluation, practice and drill, and selection and gradation of arithmetical contents. Designed for teachers and supervisors in elementary schools. One course. *Petty*

202. Comparative and International Education: Industrialized Nations. Structure and functioning of educational institutions in selected developed societies. Relevant social science theory and methods emphasized. One course. *Di Bona*

206. Studies in the History of Educational Philosophy. The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course. *Carbone*

207. Social History of Twentieth-Century American Education. Tweneth-century American education in the context of social and intellectual history. One course. *Johnson*

215S. Secondary Education: Principles. Principles, curriculum, and methods in secondary education. Prerequisite: *C* average overall and in teaching field or fields. Must be accompanied by Education 216. Half-course. *Cartwright, Githens, Johnson, and Shuman*

216. Secondary Education: Internship. Supervised internship in junior or senior high school. Full-time observation and teaching for half a semester. Preequisites: Education 215S, *C* average overall and in the major or teaching field; preparation for a teaching field; or the consent of the instructor. This course combined with Education 215S will fulfill the seminar and independent study requirement. One and one-half courses. *Cartwright, Githens, Johnson, and Shuman*

217. The Psychological Principles of Education. An advanced study of eaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. One course. *Davis and Gehman*

218. Comparative and International Education: Developing Societies. Structures and functioning of educational institutions and processes in developing nations. One course. *Di Bona*

219. Comparative and International Education: South Asia. Traditional and modern educational developments in India and Pakistan. One course. *Di Bona*

221. Programs in Early Childhood Education. Examination of the objecives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. One course. *Flowers*

222. New Developments in Elementary School Curriculum. The open lassroom, team teaching, non-graded programs, and individualized instruction. Assessment of recent emphasis on early childhood education and the middle school. One course. *Sublett*

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. *Cartwright*

226. Teaching Reading in the Elementary School. A study of the naure of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmenta and remedial programs. Practice is provided with elementary-school childre suffering reading retardation, in testing, diagnosis, and daily remedial teaching. On course. *Adams*

236. Teaching Reading in the Secondary Schools. A study of the natur of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmenta and remedial programs. For secondary-school teachers of all subjects who wish t improve the reading and study habits of their students. One course. *Adams*

237. The Teaching of Literature in Secondary Schools. Literature gener ally taught in secondary schools. Adult and transitional literature are considere Methods of organizing the program and of teaching literature. One course *Shuman*

239. The Teaching of Grammar, Composition, Mechanics, and Usag in Secondary School. Recent developments in the teaching of grammar, composition, mechanics, and usage. Students will write and grade compositions. Ter project. One course. *Shuman*

241. Principles of Guidance. An historical survey of the philosophies o guidance; a study of the interrelationships between instruction, administration, an guidance in education. Prerequisite: six hours of psychology or educational psychology. One course. *Ballantyne and Colver*

246. The Teaching of Mathematics. This course deals with such topic as aims, curriculum, course and lesson planning, and classroom procedure fo teaching secondary-school mathematics. One course. *Troy*

253. Law and Education. The elements and problems of educational organization which have come within the purview of constitutional and legislative provisions and appellate court decisions. One course. *Martin*

255. Assessment of Abilities. The selection, use, and interpretation o various instruments for predicting and evaluating the outcome of educational experiences including surveys of standardized tests of aptitude and achievement. On course. *Colver*

256. Classroom Assessment of Student Achievement. The technique used by classroom teachers to evaluate student progress. Special emphasis will b directed to tests written by teachers. One course. *Colver*

258. Assessment of Personality, Interests, and Attitudes. The rational construction, use, and interpretation of standardized instruments designed for th assessment of students' interests, attitudes, and personality. Emphasis on counse ing applications. Prerequisites: Education 243 and 255 or approval of instructo One course. *Weitz and Colver*

266. Basic Science for Teachers. Presentation of basic concepts in natura and physical science through selected readings, the use of simple experiments an demonstrations, construction and use of equipment, and field studies. One course *Githens*

276. The Teaching of High-School Science. Discussion, lectures, an collateral reading related to such topics as aims, tests, curriculum, classroom an aboratory procedure, field trips, and course and lesson planning for secondary-school science. One course. *Githens*

DEPARTMENTAL MAJOR

Undergraduate majors in education at Duke University are offered in elementary-school education and science education.

The Department offers work leading to graduation with distinction. See the ection on Honors in this *Bulletin.*

Majors in Elementary Education and Science Education. Students desiring o teach in elementary schools or science in secondary schools should read the descriptions of these programs of study listed under the proper headings elsewhere in his *Bulletin.*

Materials and Methods Courses. Certain courses concerned with materials nd methods in teaching the various subjects in the public school curriculum are isted in the proper subject matter department. These courses are intended to give redit for teaching certificates and are recommended by the Department of Education for such credit.

STUDENT TEACHING

During the eight weeks of student teaching, students should plan to live in a ommunity which is some distance from Durham. This will entail some additional iving expense to be borne by the student teacher. Room rent refund is not made.

English

Professor Ferguson, *Chairman;* Professor Williams, *Director of Undergraduate Studies;* Associate Professor Gerber, *Supervisor of Freshman Instruction;* Professors Anderson, Bevington, Budd, Duffey, Lievsay, Nygard, Price, Randall, Reiss, Sanders, Smith, and Turner; Associate Professors Clubbe, Harwell, Jackson, ones, Krueger, Mellown, Michalak, Monsman, Reardon, Strandberg, and Wetherby; Assistant Professors Adams, Applewhite, Butters, Clum, and DeNeef; Visiting Assistant Professor Locke; Lecturer Vick

WRITING AND LANGUAGE

1. Freshman Composition. Weekly expository themes based on British and American prose fiction and non-fiction; one general lecture, one section meeting, and one individual conference each week. One course. *Staff*

65S, 66S. Imaginative Writing. Informal essay, short story, poetry, drama, and film. Consent of the instructor required. Two courses. *Monsman*

101S. Advanced Expository Writing. Designed for students interested in expository writing, this is a course in advanced composition. It includes also business letters and reports. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Harwell*

102S. The Composition of Prose Narrative. The writing of a novel or novella. Primarily for juniors and seniors; consent of instructor required early in the preceding semester. One course. *Price*

103S, 104S. Creative Writing. Class discussion of students' manuscrip and individual conferences with the instructor. Open to sophomores, juniors, ar seniors. Students desiring admission to either course should present a piece writing to the instructor as early as possible during the preceding semester. Tw courses. *Applewhite, Bevington, Monsman, and Price*

107. Introduction to Linguistics. Origin and nature of language; metho of descriptive linguistics with reference to historical and comparative linguistic Prerequisite: sophomore standing. One course. *Butters*

108. Development of the English Language. An elementary historic study of the English language: patterns of change and growth, with some attenti to methods of philological inquiry and the relations of philology to literary studie One course. *Butters*

109. Modern English Grammar. A descriptive study of written and spoke American Engish of the present time, with attention to standards of usage an pronunciation and the relations of grammar to composition. One course. *Butte*

ENGLISH AND AMERICAN LITERATURE

Introduction to Literature. One course each; English 26 may be taken twic

20. (Not a course. This number represents one course credit for advance placement.)

21S. Studies in the Novel.
22S. Studies in Drama.
23S. Studies in Drama and Poetry.
24S. Studies in Poetry.
25S. Studies in Epic.

26. Studies in Special Topics. (Many of the sections of this course a taught as seminars; the Schedule of Courses should be consulted.)

55, 56. Representative British Writers. Usually these works are studie in the first semester: Chaucer's Prologue to *The Canterbury Tales* and at least tw tales, Shakespeare's *I Henry IV*, *Hamlet* or *King Lear*, and one other play, Joh Donne's poetry (selections), Milton's *Paradise Lost* (selections) and some of th shorter poems; in the second semester: novels by Fielding (*Joseph Andrews*) an Dickens (*Great Expectations*), and selections from the poetry of Pope, Word worth, Keats, and Yeats. Two courses. *Staff*

57, 58. Representative American Writers. Selections and complete work The first semester includes Poe, Emerson or Thoreau, Hawthorne, Melville, Whi man, Dickinson, and Twain; the second semester includes James, Frost or Robi son, Crane or Dreiser, O'Neill, Faulkner, Hemingway, and others. Open to junio and seniors with the permission of the Director of Undergraduate Studies. Prospe tive majors should take courses numbered 173 through 176 instead of this cours Two courses. *Staff*

112. English Literature of the Middle Ages. A study of the princip forms and examples of English prose, poetry, and drama of the Anglo-Saxon ar Middle English periods (excluding Chaucer), read in translation. One cours *Reiss*

115. Chaucer. *The Canterbury Tales* and the minor poems, with atte tion to their literary and social background. One course. *Adams, Nygard, ar Reiss*

121. English Literature of the Sixteenth Century. Emphasis in poetry on Vyatt, Sidney, Spenser, Raleigh, Shakespeare; in prose on Sidney and Florio's *ontaigne;* in drama on Marlowe. One course. *DeNeef and Krueger*

123, 124. Shakespeare. In the first semester twelve plays before 1600; the second semester about ten plays after 1600. Two courses. *DeNeef and rueger, and Williams*

125. English Literature of the Early Seventeenth Century. Emphasis in oetry on Jonson and the cavaliers, Donne and the metaphysicals; in drama on nson, Tourneur, Webster, Ford; in prose on character writers, and Bacon, Burton, onne, Browne. One course. *DeNeef and Krueger*

126. English Literature of the Late Seventeenth Century. Emphasis in oetry on later metaphysicals, and Cowley, Denham, Waller, Dryden; in prose on aylor, Dryden, Hobbes, Locke; in drama on Dryden, Congreve, Etherege, Vycherley. One course. *DeNeef*

127. Milton. Milton's poetry and prose, their relation to the period and to ther great works of literature. One course. *Lievsay and Price*

129. English Drama from the Middle Ages through the Eighteenth entury. Emphasis on Tudor and Stuart drama, exclusive of Shakespeare. One ourse. *Clum and Reardon*

131, 132. Eighteenth-Century Literature. The writers emphasized in the rst semester are Pope, Swift, Defoe, Addison, Steele, and Fielding; in the second emester, Johnson, Gray, Boswell, Goldsmith, Sheridan, Blake, and later novelists. wo courses. *Ferguson and Jackson*

138. The English Novel From the Beginnings to 1800. Some of the writrs studied are Nashe, Deloney, Lyly, Sidney, Bunyan, Behn, Defoe, Richardson, ielding, Smollett, and Sterne. One course. *Jackson*

141, 142. English Literature of the Early Nineteenth Century. The course egins with the forerunners of Romanticism. The chief emphasis in the first semesr is on the work of the older Romantics: Wordsworth, Coleridge, Lamb, and azlitt. In the second semester the chief emphasis is on the work of the younger omantics: Byron, Shelley, Keats, and DeQuincey. Two courses. *Applewhite, lubbe, and Sanders*

145, 146. English Literature, 1832-1900. A study of the major writers of oetry and prose from Macaulay to Hardy. In the first semester, Macaulay, Tenyson, Carlyle, the Brownings, Newman, Mill, Clough, and FitzGerald; in the econd semester, Arnold, the Rossettis, Ruskin, Patmore, Meredith, Huxley, Moris, Swinburne, Pater, and Hardy. Collateral reading from novels of the period. Two ourses. *Harwell, Monsman, and Sanders*

148. The English Novel in the Nineteenth Century. Some of the writers tudied are Scott, Austen, Dickens, Thackeray, Trollope, the Brontes, George Eliot, eredith, Butler, and Hardy. One course. *Harwell and Monsman*

151, 152. English Literature of the Twentieth Century. Emphasis on rincipal writers of fiction, drama, and poetry. First semester: usually Conrad, haw, Yeats, Wells, Synge, Forster, Woolf, and Joyce. Second semester: usually awrence, Cary, Huxley, Auden, Greene, Beckett, and Dylan Thomas. Two ourses. *Bevington, Mellown, and Smith*

153, 154. Twentieth-Century Poetry. A study of twentieth-century poetr and criticism of poetry in England and America. Problems in critical analysis an interpretation. First semester: the emphasis is on sources in nineteenth-centur Symbolism and on the poetry of Hopkins, Yeats, Eliot, Pound, and Stevens. Secon semester: the emphasis is on the poets and the poetic theories of the last thirt years. Two courses. *Bevington, Mellown, and Smith*

158. The English Novel in the Twentieth Century. Some of the writer studied are Conrad, Lawrence, Forster, Joyce, Woolf, Huxley, Cary, Amis, an Golding. One course. *Mellown and Smith*

159. English and Irish Drama of the Nineteenth and Twentieth Centuries. Emphasis on the modern period. One course. *Reardon*

173. American Literature to 1800. Colonial authors, Bradford, Taylor Cotton Mather, Edwards, Byrd, and Franklin, and authors of the early Republi such as Tyler, Freneau, and C. B. Brown. One course. *Staff*

174. American Literature from 1800 to 1860. Prose and poetry of American Romanticism: Emerson, Thoreau, Hawthorne, Poe, Melville, and Whitman (Not open to students who have taken the old 137.) One course. *Staff*

175. American Literature from 1860 to 1915. Dickinson, Twain, James the social and philosophical essayists, Crane, Dreiser, Robinson, and Frost. (No open to students who have taken the old 138.) One course. *Staff*

176. American Literature since 1915. Poetry, fiction, drama, and critica prose from Stein, Anderson, O'Neill, Hemingway, and Faulkner to such contemporary authors as Malamud and R. Lowell. (Not open to students who have taker the old 138.) One course. *Staff*

177, 178. American Fiction. A survey of the novel and the short story. The first semester covers the nineteenth century from Washington Irving to Stephen Crane; the second semester covers the twentieth century through ten representative books. Two courses. *Anderson, Budd, and Clum*

179. American Drama. Representative plays from Colonial times to the present: an historical survey. One course. *Reardon*

Conference Courses. Seminars primarily for majors, with priority given to seniors. Emphasis on literary theory and critical writing, with intensive study of one or more authors. One course each; each course may be taken twice.
180S. Conference on Criticism.
181S. Conference on Drama.
182S. Conference on Poetry.
183S. Conference on Fiction.
184S. Conference on Prose Non-Fiction or a Special Topic.

186. Modern Critical Methods. Major schools of modern criticism: formalistic, moralistic, psychological, biographical, historical, textual, mythic, aesthetic. Emphasis on theoretical and practical writings of representative critics. One course. *DeNeef*

191, 192, 193, 194. Independent Study. Directed reading and research. Students should consult the Director of Undergraduate Studies as early as possible in the semester preceding enrollment. One course each. *Staff*

195T. Tutorial. Directed reading and research. Prerequisite: approval of Director of Undergraduate Studies the preceding semester. One course. *Staff*

197T, 198T. Distinction in English. Tutorials in the reading and criticism of selected British and American writers. Three essays the first term; three essays or an extended paper the second term. Upon recommendation of the tutors and completion of other requirements, the student may graduate with distinction in English. Admission by invitation of the department; students expecting to graduate early may take these courses in reverse sequence, beginning in the spring term preceding their graduation. Two courses. *Anderson, Jackson, Jones, and Mellown*

FOREIGN LITERATURES (IN TRANSLATION)

161. The European Background of English Literature. Influence of ancient and mediaeval literature. One course. *Harwell*

163, 164. Readings in European Literature. European literature in trans-ation related to similar works in English. The first semester includes works by Rabelais, Cervantes, Voltaire, Goethe, and others. The second semester includes works by Balzac, Dostoevsky, Ibsen, Kafka, Sartre, Camus, and others. Two courses. *Clubbe*

165. Readings in Scandinavian Literature. A study of selections in trans-ation from Ibsen, Strindberg, Lagerkvist, and others; their place in the literary tradition of Scandinavia and their relationships with English and American litera-ure. One course. *Anderson*

169. Modern European Drama. Ibsen to the present; the free theatre movement and the drama of ideas. One course. *Reardon*

SPEECH AND THEATER

50. Essentials of Public Speaking. A basic course in public speaking, designed to give the student the poise and confidence necessary to think and speak freely before an audience. Particular attention is paid to the gathering and organization of speech materials and to oral presentation. Not open ordinarily to juniors and seniors. One course. *Michalak*

100. English for Foreign Students. Designed to assist the student to whom English is a second language to perfect his speaking and understanding of the anguage. Drills in writing, speaking, listening, and the American idiom. Open to all students and their wives, and to any persons and spouses with an official connection with the University. Those who do not pay full-time student fees may register for a fee of $5.00. No credit. *Staff*

110. Essentials of Public Speaking. A basic course in public speaking for juniors and seniors dealing with the same matters as 50. (Not open for credit to students who have taken 50.) One course. *Michalak*

119. History of the Theater. The origin and development of drama, acting, and stagecraft from ancient Greece to the modern European and American theater. Production problems of representative plays of the various periods will be discussed. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

120. Stagecraft. An introductory course on the technical aspects of play production: scenery, lighting, properties, make-up, and costuming. Laboratory work will be coordinated with the various productions of the Duke Players. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

130. Play Production. An introduction to the methods of producing a pla —theater organization, play selection, casting, and rehearsal. Lectures and laboratory. Primarily for juniors and seniors; open also to sophomores approved by th instructor. One course. *Michalak*

139. The Speaking Voice. A study of the mechanisms of speech. Emphasi is placed on providing the skills necessary for the improvement of voice, pronunciation, and diction. Methods of correcting minor functional speech disorders wil also be studied. One course. *Wetherby*

140S. Argumentation. The principles of argumentation and debating. Th techniques of analysis, investigation, evidence, reasoning, brief making, and refutation. Participation in class discussions and debates. One course. *Wetherby*

150. Persuasive Speaking. The psychological and sociological technique used in gaining acceptance of ideas through speech. Study is made of the factor influencing human behavior; audience analysis and motivation; choice, arrangement, and adaptation of material. Extensive practice in persuasive speaking. On course. *Wetherby*

160, 170. Broadcasting. A study of the background of radio and television broadcasting. The first semester covers the development of broadcasting a an industry and as a literary form. The second semester studies the legal and socia aspects, and various program forms. Two courses. *Wetherby*

GRADUATE COURSES OPEN TO UNDERGRADUATES

207, 208. History of the English Language. Old to Modern English developments in phonology, morphology, syntax, and vocabulary. First semester Old English; second semester, 1100 to the present. Two courses. *Nygard an Reiss*

209. Present-Day English. A description of present-day American Englis from the point of view of modern linguistic theory; comparison of traditional an structural grammars; semantic change; the relation of the written to the spoke language; usage. One course. *Nygard and Reiss*

210. Old English Literary Tradition. Poetry: heroic traditional (aside fro *Beowulf*), the elegiac tradition, and the Caedmonian and Cynewulfian schools Prose: Alfred, AElfric, and Wulfstan. Prerequisite: English 207. One course *Nygard and Reiss*

212. Middle English Literary Tradition. From 1100 to 1500 (excludin Chaucer); medieval genres; reading of selected texts. A reading knowledge of Ol or Middle English is recommended. One course. *Nygard and Reiss*

215. Chaucer. *The Canterbury Tales.* One course. *Nygard and Reiss*

216. Chaucer. *Troilus and Criseyde* and the minor poems. One course *Nygard and Reiss*

221. English Prose of the Sixteenth Century. Readings in the major form and authors. One course. *Lievsay*

222. English Non-Dramatic Poetry of the Sixteenth Century. Extensive select readings from representative types and authors, excluding Spenser. One course. *DeNeef and Lievsay*

223. Spenser. The reading of Spenser's works, with chief attention to *The Faerie Queene*. One course. *Lievsay*

224. Shakespeare. The plays. One course. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. First semester: Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. Second Semester: Jonson, Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. Two courses. *Randall*

229, 230. English Literature in the Seventeenth Century. Major works in prose, poetry, and drama from 1600 to the death of Dryden. Two courses. *Lievsay, Randall, and Williams*

232. Milton. Milton's poetry and prose, with emphasis on the major poems. One course. *Lievsay*

234. English Drama, 1642-1800. The heroic play and the comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. One course. *Jackson*

235, 236. The Eighteenth Century. Swift, Pope, Defoe, Addison, Steele, and others are studied in the first semester; in the second, Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. Two courses. *Ferguson and Jackson*

241, 242. English Literature of the Early Nineteenth Century. The Romantic poets and prose writers: first semester, 1790-1810, with emphasis on Wordsworth, Coleridge, and Scott; second semester, 1810-1830, with emphasis on Byron, Shelley, and Keats. Two courses. *Clubbe and Sanders*

245, 246. English Literature of the Later Nineteenth Century. The first semester is devoted chiefly to Carlyle, Dickens, Thackeray, Tennyson, and Browning; the second semester to Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. Two courses. *Clubbe, Monsman, and Sanders*

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. The first semester will include Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence; the second semester, Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. Two courses. *Mellown and Smith*

263, 264. American Literature, 1800-1865. The writers emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. Two courses. *Anderson, Budd, Jones, and Turner*

267, 268. American Literature, 1865-1920. Selected works of representative authors. The first semester will include Whitman, Lanier, Mark Twain, James, Howells, Emily Dickinson, and the Local Colorists; the second semester, Crane, Norris, Moody, London, Dreiser, Edith Wharton, O'Neill, Robinson, and Frost. Two courses. *Budd*

270, 271. Southern Literature. The principal authors and the chief literar developments from the beginnings to the present. Emphasis in the first semester i on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Mark Twain, Ellen Glasgow, and Faulkner. Attention is given t the historical and cultural background and to literary relations extending outsid the region. Two courses. *Turner*

275, 276. American Literature Since 1920. First semester, selected fictio from Gertrude Stein to the present. Second semester, poetry from the Imagist movement to the present. Two courses. *Duffey and Strandberg*

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the method of folklore investigation; and the relation of these popular genres to literary tradition. One course. *Nygard*

285. Literary Criticism. Readings from the major critics, Plato to th eighteenth century with emphasis on formative ideas and historical continuity One course. *Lievsay*

287. Recent Critical Thought. Questions of the nature and value of literature as reflected in recent criticism, theoretical and practical. One course. *Duffey*

289. Literary Biography. Selected works from Plutarch to Strachey with discussion of the historical development of biography, the various methods it has used, and the various theories which have been held about it. One course. *Sanders*

DEPARTMENTAL MAJOR

Basic Requirement. English 55-56.

Major Requirements. Six courses above the sophomore level including one course in one of the major authors: Chaucer, Shakespeare, Milton; two courses in one of the two-semester historical surveys of British or American Literature; two courses in areas not represented by the historical survey chosen (one in each area)—(*a*) British Literature before 1800, (*b*), British Literature after 1800, and (*c*) American Literature; and one additional course given in the English Department (in writing, speech, drama, literature, or language).

The English Department recommends that its majors complete at least two years of college-level study, or the equivalent, of a foreign language. Those majors contemplating graduate work in English should note that many M.A. programs require examination in one foreign language and that Ph.D. programs commonly require examination in two.

The Department offers work leading to Graduation with Distinction. For further information consult the Director of Undergraduate Studies; see also the section on Eligibility for Academic Honors in this *Bulletin.*

Forestry

Undergraduate students who are preparing for professional careers in forest resource sciences or administration should enroll in the Academic-Forestry Program as given in the section on professional combination courses (p. 22).

Other undergraduate students in arts and sciences with adequate preparation and permission of the instructor may elect the following courses:

152. Conserving Natural Resources. Fundamentals of natural resource evelopment, use, management, and protection based on principles of the natural nd social sciences. One course. *Staff*

203. General Meterology. Prerequisites: introductory courses in calculus nd physics. One course. *Vukovich*

204. Microclimatology. Prerequisites: introductory courses in calculus and hysics. One course. *Knoerr*

205. Tree Growth and Development. Prerequisites: introductory courses botany and chemistry. One course. *Barnes*

215. Air Pollution Meteorology. Prerequisite: Forestry 203 or equivalent. Course sponsored by Triangle Universities Consortium on Air Pollution and ught by faculty from N. C. State University). One course. *Staff*

222. Biology of Forest Insects and Diseases. Prerequisites: introductory ourses in biology and physiology. One course. *Anderson and Stambaugh*

233. General Entomology. Prerequisite: Forestry 222 or equivalent. One ourse. *Anderson*

241. Dendrology (Taxonomy of Forest Trees). Prerequisite: introductory ourse in botany. One course. *Harrar and White*

243. Natural Resource Ecology. Prerequisite: introductory course in otany. One course. *Wuenscher*

250. Biometry. Prerequisite: introductory course in calculus. One course. *andle*

269. Resource Economics and Policy. Prerequisite: introductory course n economics. One course. *Convery*

273. Economics and Environmental Quality. Prerequisite: introductory ourse in economics. One course. *Convery*

290. Wood Anatomy. Prerequisite: Forestry 241 or plant anatomy. One ourse. *Harrar*

Course descriptions and other courses that might serve the interests of ndividual students are given in the *Bulletin of the School of Forestry.*

French

For courses offered in French, see *Romance Languages.*

Genetics—The University Program

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology and Immunology), Buettner-Janusch (Anatomy and Zoology), and Guild (Biochemistry); Associate Professors Antonovics (Botany), Boynton (Botany), Gillham (Zoology), Kelley (Medicine and Biochemistry), C. Ward (Zoology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), Harriman (Bic chemistry), Kredich (Medicine and Biochemistry), Luftig (Microbiology an Immunology), and F. Ward (Microbiology and Immunology)

For a description of the following courses consult the listings under the spec ified departments.

The University Program in Genetics provides a coherent course of study i all facets of biology related to genetics. Students interested in preparation for ad vanced work in genetics or wishing to take an interdisciplinary major in this are should consult with Dr. Ward (032 Biological Sciences Building). Informatio concerning interdisciplinary programs involving biology should be discussed wit the appropriate directors of undergraduate studies.

117. Heredity and Society. (Listed as Zoology 117.) One course. *War*

180. Principles of Genetics. (Listed as Botany 180, Botany 280, Zoolog 180, and Zoology 280.) One course. *Antonovics, Boynton, and Gillham*

186. Evolution. (Listed as Botany 186, Zoology 186, and Zoology 286.) One course. *Antonovics and Lundberg (Zoology)*

204. Introductory Genetics. (Listed as Biochemistry 204.) Half-course *Gross and Staff*

215. Bacteriophage: Structure and Function. (Listed as Microbiolog and Immunology 215.) Half-course. *Luftig and Nichols*

216. Molecular Genetics. (Listed as Biochemistry 216.) One course *Guild and Staff*

236. Human Genetics. (Listed as Anatomy 236, Anthropology 236, an Zoology 236.) One course. *Buettner-Janusch*

280. Principles of Genetics. (Listed as Botany 280 and Zoology 280.) One course. *Antonovics, Boynton, and Gillham*

282. Experimental Genetics. (Listed as Biochemistry 282.) Half-course *Hall, Harriman, and Staff*

284. Current Topics in Genetic Mechanisms. (Listed as Biochemistr 284.) Half-course. *Hall and Staff*

285. Population Genetics and Evolution. (Listed as Botany 285 in the *Graduate Bulletin.*) One course. *Antonovics and Staff*

286. Evolution. (Listed as Botany 186, Zoology 186, and Zoology 286.) One course. *Antonovics and Lundberg (Zoology)*

288. The Cell in Development and Heredity. (Listed as Anatomy 288 and Zoology 288.) Half-course. *Counce, Gillham, and Staff*

Independent Study and *Special Problems* are offered in the Department o Botany under 191, 192, 193, 194, 225, and 226, and in the Department of Zoology under numbers 191 and 192. A student should obtain the permission of both the instructor with whom he wishes to work and the appropriate director of undergraduate studies before registering for these courses.

Geography

For courses offered in Geography, see *Economics*.

Geology

Professor Heron *Chairman;* Associate Professor Furbish, *Director of Undergraduate Studies;* Associate Professors Perkins, Pilkey, and Lynts

1. Geological Environments and Man. Physical and chemical environments acting on the earth with special emphasis on their interaction with man. Three lectures and proficiency sessions to be arranged by students. One course. *Heron and Perkins*

1P. Preceptorial. Field trips. Four hours once a month on Saturday. Elective for students enrolled in Geology 1. *Staff*

2. History of the Earth. Including the physical development and the geological evolution of life. Three one-hour lectures and one two-hour laboratory. Prerequisite: Geology 1 or consent of instructor. One course. *Heron and Lynts*

2P. Preceptorial. A weekend field trip to the classic Paleozoic section in the Appalachians of Virginia and West Virginia in early April, and a one day field trip through the Deep River Triassic Basin in late April. Elective for students enrolled in Geology 2. *Staff*

53. Introductory Oceanography. Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one year laboratory science or concurrent enrollment in a laboratory science. (Also listed as Botany 53.) One course. *Pilkey and Searles*

54. Environmental Oceanography. The interaction of man and the marine environment. Lecture and field trips. Given biennially. One course. *Pilkey*

101. Crystallographic Mineralogy. Definition of the crystalline state, lattice and group concepts, indices, crystal systems, classification, and crystal morphology. Lectures and laboratory. One course. *Furbish*

102. Fundamentals of Mineralogy. Crystal chemistry, crystal physics, mineral identification, and genesis. Lectures or recitations, laboratory, and field trips. Prerequisite: Chemistry 12 (may be taken concurrently) and Geology 101. One course. *Furbish*

106. Igneous and Metamorphic Rocks. Silicate mineralogy, theory of origin and classification of igneous and metamorphic rocks and rock identification. Lectures and laboratory. Prerequisite: Geology 102. One course. *Furbish*

108. Sedimentary Rocks. Authigenic and detrital minerals, theory of origin and classification of sedimentary rocks and rock identification. Lecture, laboratory, and field trips. Prerequisite: Geology 1. One course. *Heron*

164. Introduction to Geologic Field Methods. Principles and techniques used in geologic mapping and field studies including applicable methods of surveying and the use of aerial photographs. Lectures. laboratory, and field trips. Prerequisites: Geology 1 and 2. One course. *Furbish*

169. The Marine Environment. For description see Marine Sciences.

171. Marine Sciences Seminar. For description see Marine Sciences.

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors and seniors by permission of the Director of Undergraduate Studies. Two courses. *Staff*

For Advanced Undergraduates and Graduates

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. Not open to students who have completed Geology 206. (Given at Beaufort only.) Two courses. *Pilkey*

206S. Principles of Geological Oceanography. A survey of geological aspects of the oceans including sediment types, processes of sedimentation, geologic structures of the ocean basins, and bottom physiography. Prerequisite: Geology 108 or consent of instructor. One course. *Pilkey*

208. Shallow-Marine Geology. Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. Give biennially. One course. *Perkins*

211S. Stratigraphic Principles and Application. Prerequisite: Geology 108. One course. *Perkins*

213. Sedimentology. Parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. *Pilkey*

214S. Sediments in Thin Section. Study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Prerequisite: Geology 213 or consent of instructor. One course. *Perkins*

222. Sedimentary Minerals. Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. One course. *Heron*

229. Economic Geology. Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisite: Geology 102. Given on demand. One course. *Furbish*

230. Principles of Structural Geology. Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. Given biennially. One course. *Furbish*

241-242. Invertebrate Paleontology. Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Lectures and laboratory. Prerequisites: Geology 1, 2, or consent of instructor. Given biennially. Two courses. *Lynts*

243-244. Micropaleontology. Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution, and stratigraphic distribution. Lectures and laboratory. Prerequisites: Geology 241-242, or consent of instructor. Given biennially. Two courses. *Lynts*

247. Paleoecology. Application of ecologic and geologic principles to the reconstruction of the interrelationship between organisms and their environment in geologic time. Prerequisites: Geology 213, 242, or consent of instructor. Given biennially. One course. *Lynts*

DEPARTMENTAL MAJOR

The A.B. Degree

The Department of Geology offers two programs:

1. Geology

Prerequisites. Geology 1 and 2, Chemistry 11 and 12 and Mathematics 31 and 32.

Major Requirements. A minimum of eight geology courses above the introductory levels, including 101, 102, 106, 108, 164, 211, and 230.

2. Geology: Preparatory to Advanced Studies in Oceanography

Prerequisites. Geology 1, 2, and 53 (or 206), Chemistry 11 and 12, Physics 1 and 2, Biology 11 and 12 or Biology 14, calculus and three courses of science electives.

Major Requirements. A minimum of six geology courses above the introductory levels, including 101, 102, 106, 108, 211, and 230.

The B.S. Degree

Prerequisites. Geology 1 and 2, Chemistry 11 and 12, Mathematics 31, 32, and 51.

Major Requirements. A minimum of ten courses, above introductory level. including 101, 102, 106, 108, 211, 230, plus a field course normally taken during the summer of the junior year.

Germanic Languages and Literature

Professor Phelps, *Chairman;* Assistant Professor Novak, *Director of Undergraduate Studies;* Assistant Professor Bessent, *Supervisor of Freshman Instruction;* Professor Salinger; Associate Professor Borchardt; Assistant Professors Alt and Stern; Instructors Klabes and Von Ramm

1-2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Two courses. *Bessent and Staff*

63. Intermediate German. Prerequisite: German 1-2 or equivalent. One course. *Staff*

German 63 followed by 91, 117, 182 or the equivalent of such a two-semester sequence is prerequisite for all 100-level literature courses in German.

91, 92. Introduction to German Literature. Readings from representative German authors. Two courses. *Staff*

91P, 92P. Preceptorial. Elective preceptorial for students enrolled in German 91, 92. *Staff*

93S, 94S. Seminars for Freshmen and Sophomores. German literature i English translation. Topics to be specified each semester. Juniors and senior admitted only with permission of the Director of Undergraduate Studies. Tw courses. *Staff*

105. Composition. Syntax with practice in the elements of German expository prose style, restricted to majors. Half-course. *Staff*

109S, 110S. German Prose Fiction. Origin and development of the Germa novel and short story with special emphasis on the nineteenth century. Two courses *Alt*

115S. German Drama of the Nineteenth Century. Leading dramatist from Kleist to Hauptmann. One course. *Alt*

116. German Drama of the Twentieth Century. Expressionism throug Epic Theater to Günter Grass. One course. *Alt and Borchardt*

117, 118. German Conversation. A course primarily in speaking Germa with some practice in writing, restricted to German majors and other students b permission of the department. Two courses. *Bessent*

119S, 120S. Survey of German Literature. German literature and it cultural background. First semester: from the beginnings to the Romantic period Second semester: from Romanticism to the present. Lectures, reports, and reading Two courses. *Novak, Alt, and Borchardt*

125, 126. Modern German Literature. A study of representative works o the twentieth century. Two courses. *Novak*

125P, 126P. Preceptorial. Elective preceptorial for students enrolled i German 125, 126. *Staff*

130. German Life and Thought. German cultural and intellectual history. Reading and discussion in English. One course. *Borchardt*

131, 132. Introduction to the Age of Goethe. Selected works of Lessing Goethe, and Schiller. Two courses. *Phelps and Salinger*

133S, 134S. The German Lyric. A survey of the development of Germa lyric poetry, principally from Klopstock to Rilke (with some attention to mediaeva and modern poets), seen as poetic reflection of German thought. Two courses. *Salinger*

171. German Literature before 1900 in English Translation. One course *Borchardt*

172. Modern German Literature in English Translation. Representativ works by such writers as Mann, Kafka, Hesse, Brecht, Böll, and Grass. One course *Borchardt and Phelps*

181, 182. German. An intensive introduction to the language open onl to students who have achieved proficiency in another language. Two courses *Novak*

191, 192. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission of the department. Two courses. *Alt, Borchardt, Novak, Phelps, Salinger, and Stern*

193, 194. Independent Study. Directed reading and research. Open only to qualified students in the senior year, by permission of the department. Two courses. *Alt, Borchardt, Novak, Phelps, Salinger, and Stern*

201S, 202S. Goethe. A study of his life and works, in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose, fiction, and selected dramas; second semester: *Faust I & II*. Two courses. *Phelps*

203S, 204S. Eighteenth Century. Eighteenth-century German literature in its relation to European intellectual currents of that time. Two courses. *Phelps*

205, 206. Middle High German. The language and literature of Germany's first classical period. Two courses. *Stern*

207S, 208S. German Romanticism. The principal writers of the period from 1800 to 1850. Two courses.

209S, 210S. Kleist, Grillparzer, and Hebbel. The development of the drama in Germany and Austria between Schiller and Naturalism. Two courses. *Alt and Salinger*

211S, 212S. Nineteenth-Century Literature. From the end of Romanticism through Realism. Two courses. *Alt*

213S. Heinrich Heine. A study of the poet and his impact on his age. One course. *Salinger*

214S. The Twentieth Century. Literature of the twentieth century presented through representative authors. One course.

215S. Seventeenth-Century Literature. A study of the leading writers of the Baroque, viewed against the background of their time. One course. *Borchardt*

216. History of the German Language. The development of the phonology, morphology, and syntax of German from earliest beginnings to the present. One course. *Stern*

217S. Renaissance and Reformation Literature. The period from 1400 to about 1600. One course. *Borchardt*

218S. The Teaching of German. A survey of modern teaching techniques: problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. One course. *Phelps*

219. Applied Linguistics. Phonology, morphology, and syntax of German. Introduction to the systematic study of the vocabulary of modern German. By permission of instructor. One course. *Stern*

232. Criticism and Literary Theory. Critical concepts, craft of interpretation, and readings from the great critics. One course. *Alt and Borchardt*

DUTCH

181, 182. Dutch. Intensive introduction to the language of the Netherlands. Modern readings. Completion of second year college level (or equivalent) of another foreign language will normally be required. Two courses. *Stern*

191, 192. Independent Study. Directed reading and research for qualifie juniors by permission of the department. Two courses. *Stern*

193, 194. Independent Study. Directed reading and research for qualifie seniors by permission of the department. Two courses. *Stern*

DEPARTMENTAL MAJOR

Prerequisites. German 1-2 and 63 or equivalent.

Major Requirements. Conversation (German 117, 118), or equivalent, plu six advanced courses in the German Department, three of which must be on th 200-level. Additional courses from other fields will be selected in consultatio with the departmental adviser.

Greek

For courses in Greek, see *Classical Studies.*

Health and Physical Education

PHYSICAL EDUCATION FOR MEN

Professor Friedrich, *Chairman of Health and Physical Education;* Associate Professor Skinner, *Director of Undergraduate Instruction;* Assistant Professor Corrie *Director of Intramurals:* Assistant Professor Riebel, *Supervisor of Freshma Instruction;* Professor C. Falcone; Associate Professors Buehler, Cox, and Persona Assistant Professors Harvey, LeBar, and Riebel; Instructor Hagler; Assistant Instructors J. Falcone and Dainis

Required Courses

Two semesters of physical education is required for graduation unless a student is excused for medical reasons. The requirement is met by the satisfactory completion of P.E. 1, Foundations of Physical Education, plus one semester of a physical education activity course or by an alternate form of activity approved by the Men's Physical Education Department. This work will normally be completed in the freshman year.

All students are given a medical and physical examination before registration. Freshman who have physical disabilities which prevent them from participating in regular classes, should register for P.E. 11-12, Adapted Physical Education. Students who do not pass the basic swimming test are expected to register for P.E. 20, Beginning Swimming, during the spring semester of the freshman year.

Physical education courses and independent activities are graded on an A,B,C basis. These grades are not counted toward continuation, graduation, or honors; neither are physical education required courses counted among the 32 courses needed for graduation.

1. Foundations of Physical Education. Information and activities related to health and fitness, including techniques in body mechanics, relaxation, control of weight, and posture. Orientation to various sports activities. On the basis of tests and factors such as body type, students are guided into those areas that best provide for their present and future needs. No course credit. *Staff*

11-12. Adapted Physical Education. Instruction adapted to the needs and capacities of students who have physical disabilities which prevent them from participating in P.E. 1-2. No course credit. *Staff*

20. Beginning Swimming. This requirement may be waived by passing a departmental swim test.

Freshman Activity Courses

The activity courses listed below are electives for the second semester of the freshman year. Prerequisite: P.E. 1. No course credit.

15. Individual Development
21. Intermediate Swimming
25. Swimming and Life Saving
26. Advanced Swimming and Water Safety
30. Golf
32. Handball-Badminton
33. Fencing-Archery
35. Soccer-Lacrosse
40. Tennis-Volleyball
41. Gymnastics
42. Combatives

Elective Activity Courses for Men

The activity courses listed below may be taken as electives on a pass-fail basis provided the following requirements are met: (1) They must be different or more advanced than courses the student has taken previously. (2) The student must enroll in two semesters of activity courses in order to receive a half-course credit. (3) The maximum amount of credit which a student may earn for elective physical activity courses is one full course. Prerequisites: two semesters of required physical education.

100-101—Adapted Physical Education
110-111—Individual Development
121—Intermediate Swimming
125—Swimming and Life Saving
126—Advanced Swimming and Water Safety
127—Scuba Diving
130—Golf ($25.00 fee)
132—Badminton/Handball
133—Fencing/Archery
140—Tennis/Volleyball
141—Gymnastics
142—Combatives

Certain non-credit departmental sponsored activities may be scheduled during the year. Included in this group of activities are: sailing, bowling, skiing, judo, and survival skills.

Elective Professional Courses

The courses listed below are arranged to meet the increasing demand for teachers who are qualified to coach and teach physical education as well as for those who may have leadership responsibilities in the area of recreation. These courses are open as electives for students in high school teaching programs and others for whom such courses may be appropriate. Teaching majors may elect semester-courses in this group. Two semester-courses may be elected from the courses listed under Special Methods in Physical Education; three from the courses listed under Theory and Practice in Physical Education; and one from Health Education. The courses must be selected with the prior approval of the director of undergraduate studies from the student's major department, in order to meet the needs of the individual.

Special Methods in Physical Education

163. Coaching Baseball and Track in Secondary Schools. Theory and practice. Open to juniors and seniors. One course. *Buehler and Butters*

164. Coaching Basketball and Football in Secondary Schools. Theory and practice. Open to juniors and seniors. One course. *Falcone and Waters*

Theory and Practice in Physical Education

170. History and Principles of Physical Education. The objectives and scientific principles upon which physical education is based. This history of physical education is studied in order to show the changes in objectives, principles, and methods and as an aid in the interpretation of trends. One course. *Friedrich*

171. Recreational Leadership. Theories and philosophies of play and recreation with emphasis on leadership and application to community organizations, school, and family situations. One course. *Friedrich*

172. The Administration of Physical Education and Athletics in Secondary Schools. A case study appraisal of athletic health and physical education problems experienced in the organization and administration of athletics, health and physical education. Open to juniors and seniors. One course. *Friedrich*

173. Protective Practices in Physical Education. Safety and protective measures, including training and rehabilitation. Open to juniors and seniors. One course. *Staff*

Health Education

192. School Health Problems. Includes topics such as physical screening, communicable disease prevention and control, and healthful school environment. One course. *Friedrich*

PHYSICAL EDUCATION FOR WOMEN

Professor Elizabeth C. Bookhout, *Chairman:* Professor Lewis, *Director of Undergraduate Studies;* Associate Professors Eddy, Spangler, Uhrhane, and Woodyard; Assistant Professors Lloyd, Raynor, and Wray; Instructor White; Part-Time Instructors Dainis and Simpson

Required Physical Education Activity Courses

One year of physical education is required for graduation unless a student is excused for medical reasons. The requirement is met by satisfactory completion of two semesters of physical education activity courses or by an alternate form of activity approved by the Women's Physical Education Department. The work will normally be completed in the freshman year. Those who are unable to pass a survival swimming test which is given during Freshman Week must take a swimming course; otherwise, students select activity courses appropriate to their interests and backgrounds. The physical education activity courses and independent activity are conducted on a pass-fail basis.

1-2. Freshman Activity Courses. Each semester students take a full-semester or two half-semester activity courses selected from those listed below. They take a beginning, intermediate, or advanced section according to their skill background. No credit. *Staff*

Full Semester Courses

Modern Dance: Beginning, Intermediate I, Intermediate II, and Choreography
Tennis
Water Safety Instructor's Course
Independent Activity (With the approval of the department.)

Half-Semester Courses

Adapted P.E. (for students restricted from full activity)
Archery: Beginning
Badminton: Beginning and Intermediate
Basketball: Intermediate and Advanced
Bowling: Beginning and Intermediate
Conditioning Exercises
Equitation: Beginning and Intermediate
Equitation: Advanced Hunt Seat
Fencing: Beginning and Intermediate
First Aid
Folk Dance
Golf: Beginning and Intermediate
Gymnastics: Beginning and Intermediate
Hockey
Jogging
Movement Awareness
Senior Life Saving
Soccer
Softball
Square Dance
Swimming: Beginning, Intermediate, High Intermediate, Advanced, and Synchronized
Tap Dance: Beginning
Tennis: Beginning, Intermediate, High Intermediate, and Advanced
Track and Field
Trampoline and Floor Exercise
Volleyball
Independent Activity (With the approval of the department.)

Elective Physical Education Activity Courses

61-62. Sophomore Activity Courses. Students may take, as electives, the following activity courses if they are different or more advanced than activity courses taken to fulfill the physical education requirement. Prerequisite: P.E. 1-2. Half-course per year. *Staff*

161-162. Junior and Senior Activity Courses. Students may take, as electives, the following activity courses if they are different or more advanced than activity courses taken previously. Prerequisite: P.E. 1-2. Half-course per year. *Staff*

Elective Activity Courses*

Adapted Physical Education
Badminton: Beginning and Intermediate
Fencing: Beginning and Intermediate
Folk Dance: Philippine, Russian, Balkan, Israeli, and Scandinavian
Golf: Beginning, Intermediate, and Advanced
Gymnastics: Beginning and Intermediate
Modern Dance: Beginning, Intermediate I, Intermediate II, and Choreography
Senior Life Saving
Swimming: Beginning, Intermediate, Advanced, and Synchronized
Tennis: Beginning, Intermediate, High Intermediate, and Advanced
Volleyball
Water Safety Instructor's Course

*The maximum amount of credit which a student may earn for elective physical education activity courses is one full course.

Non-Credit Activity Courses

151, 152. Non-credit Elective Activity Courses. Open to upperclas women who have fulfilled the physical education requirement. No credit. *Staff*

Theory Courses in Physical Education

The courses listed in this section are open to undergraduate women majoring in physical education and are available as electives to undergraduate men and women majoring in other areas. The following courses meet distributional requirements in the social science division: P.E. 49S, 113D, 114, 130S, 131S, and 195S

49S. History of Physical Education. Relationship of physical education to social, political, and religious customs of different nations and periods. One course *Lloyd*

102. Physical Education for Early Childhood. Theory and practice in teaching basic skills, rhythms, and games to young children in grades K-3. Half-course. *Lewis*

103. Physical Education for the Intermediate Grades. Planning, organizing, and conducting physical education programs for children in grades 4-9. Half-course. *Lewis*

105. Group Leadership in Recreation. Interaction and group dynamics. Open to sophomores, juniors, and seniors. One course. *Simpson*

106. Methods and Materials in Recreation. Development of leadership skills in crafts, rhythmic activities, social recreation, and dramatics. Laboratory work includes experience with an organized recreational group. Open to sophomores, juniors, and seniors. One course. *Simpson*

113D. Mammalian Anatomy. A study of the organ systems of man, with emphasis on osteology, arthrology, and myology. One course. *Bookhout*

114. Kinesiology. A study of muscle function and analysis of human movement. Prerequisite: Physical Education 113D or Zoology 53. One course. *Bookhout*

117. Adapted Physical Education. Analysis of exercises and activities appropriate to individual needs. Theory and practice in planning and conducting adapted programs. Half-course. *Bookhout*

119S. Organization and Administration of Physical Education. A seminar on curriculum building; administration of required, intramural, and extramural programs; problems of budget, facilities, legal aspects, public relations, and safety. One course. *Bookhout*

120. Measurement and Evaluation in Physical Education. A study of the contribution of measurement and evaluation to the teaching process. Practice in test selection, administration, and interpretation. Half-course. *Bookhout*

130S, 131S. History of Dance. Emphasis on form, structure, and content related to culture of eras. P.E. 130, Prehistoric to Duncan; P.E. 131, Duncan to Present. Two courses. *Wray*

132. Creative Rhythms in Movement. Basic theory and experience in creative rhythmic movement for grades K-12. The study of the classification and elements of movement with observation and practical experiences with children. Recommended for those students interested in dance, music, recreation, and elementary and secondary teaching. One course. *Wray*

133. Social, Folk, and Square Dance Forms. A theoretical and practical study of the historical development and resources of social, folk, and square dance forms in relation to their cultural backgrounds. Half-course. *Wray*

135, 136. Principles of Contemporary Dance Composition. Prerequisite: Beginning Modern Dance and Intermediate Modern Dance I or permission of instructor. Two courses. *White or Wray*

139. Movement Connotations. Theories and forms of human movement with emphasis on sensory awareness and non-verbal communication. One course. *Wray*

181. Methods and Materials in Team Sports. Basic theory and practice in teaching team sports for women. One course. *Spangler and Woodyard*

182. Methods and Materials in Individual and Dual Sports. Basic theory and practice in teaching these sports. One course. *Staff*

185. Advanced Methods of Teaching and Officiating. One course. *Lewis and Staff*

191, 192. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. Two courses. *Staff*

195S. Recent Research in Physical Education and Related Fields. One course. *Staff*

HEALTH EDUCATION COURSES (MEN AND WOMEN)

The following health education courses meet distributional requirements in social science: H.E. 137S, 138S, 140S, and 170T.

101-102. Health Education Fundamentals, Methods, and Materials. Designed specifically for an open only to physical education majors. Basic studies in personal and community health; administration; curriculum and program planning; health services and health counseling; selection, purchase, and care of equipment; library sources; methods and materials for effective health teaching; evaluation techniques and procedures. Two courses. *Uhrhane*

134. School Health. Organization of the school health program; basic health problems in school; methods and materials for teaching about health. Primarily designed for students preparing to teach in elementary or secondary schools. Open to men and women. Juniors and seniors only. Half-course. *Uhrhane*

137S. Health in Developing Countries. Health conditions, practices, and problems interacting with economics, productivity, and progress of emerging nations with some emphasis on African states. One course. *Uhrhane*

138S. Health Problems in Metropolitan Areas. Relationships between urbanization and health illustrated by environmental hazards, population motion, food distribution, housing, city planning, poverty, drug usage, and consumer awareness. One course. *Uhrhane*

140S. Gereology and Health. Health implications in relationships withi families and between generations in the changing role of the elderly in moder society, in retirement, and in extended leisure time; illness, disability, and medic care. One course. *Uhrhane*

170T. Special Health Problems. Problems and issues in health affai selected by students for concentrated study. One course. *Uhrhane*

191, 192, 193, 194. Independent Study. Prerequisite: consent of instructo One course each. *Uhrhane*

Major in Physical Education

A major in physical education is offered to undergraduate women who wis to prepare for teaching physical education, recreational leadership, physic therapy, or graduate study. The program may also be planned with emphasis o dance or health.

Prerequisites. Biology 11-12, Biology 14, or Chemistry 1, 2; P.E. 49S History of Physical Education.

Major Requirements. Eight courses distributed as follows:

P.E. 113D. Mammalian Anatomy
P.E. 114. Kinesiology
Zoology 151. Principles of Physiology
One course in health education.
One seminar selected from P.E. 119S, P.E. 195S, H.E. 137S, H.E. 138S or H.E. 140S.
Three additional courses in physical education or health education.

Note: Students who are interested in full-time or part-time teaching in physical education and health should consult the Director of Undergraduate Studie in the Women's Physical Education Department for course selection to meet appropriate certification requirements.

History

Professor Colton, *Chairman;* Professor Hollyday, *Director of Undergraduat Studies;* Associate Professor Mauskopf, *Supervisor of Freshman Instruction;* Professors Alden, Durden, Ferguson, Holley, Lerner, Parker, Preston, Ropp, A Scott, W. Scott, Silberman, TePaske, Watson, and Young; Associate Professor Acomb, Brieger, Cahow, Cell, Davis, and Witt; Assistant Professors Bergquist Chafe, Gavins, Hartwig, Miller, and Nathans; Instructors Dirlik, Landau, an Rolf; Part-time Instructors Burgess, Greeman, Latimer, and Sipe; Visiting Professor Embree; Visiting Associate Professor Hyatt; Adjunct Assistant Professo Goodwyn

PREREQUISITE COURSES

Majors are required to take two introductory courses in history (1D-2D 51-52, 51S-52S, 53-54, 61D-62D, 91-92). Other students are urged, but no required, to take two semesters of prerequisite courses before preceding to advanced level courses. Additional courses may be chosen from this group as electives or part of the departmental major.

1D, 2D. A History of European Civilization. Major problems in the development and world impact of European civilization, critical evaluation of his-orical interpretations, and investigation of history from primary sources. From the ncient Greeks to the present. Lectures and small discussion groups. Two courses. Not open to students who have had History 51, 52 or 51S, 52S.) *Bergquist, Cell, Landau, Latimer, Lerner, Mauskopf, Miller, Oates, Witt, and Young*

51, 52. A History of European Civilization. From the Italian Renaissance o the present. (Not open to students who have had History 1-2, 51S, 52S). Two courses. *Acomb, Ferguson, Hollyday, Parker, Ropp, and W. Scott*

51S, 52S. Selected Topics in the History of European Civilization. (Not open to students who have had History 1, 2, or 51, 52.) Two courses. *Staff*

53. Greek History. (Listed also as Classical Studies 53.) One course. *Nixon*

54. Roman History. (Listed also as Classical Studies 54.) One course. *Nixon*

61D, 62D. From Tradition to Revolution. Societies in change: Asia, Africa, and Latin America. Traditional ideas and institutions of selected areas; effects of modernization. Two courses. *Dirlik, Hartwig, Silberman, Sipe, and TePaske*

91. The Development of American Democracy to 1865. A study of the rends vital to an understanding of the United States today. The main theme is the development of American democracy. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered n relation to this main theme. (Not open to freshmen.) One course. *Burgess, Cahow, Chafe, Davis, Durden, Gavins, Greeman, Holley, Nathans, and A. Scott*

92. The Development of American Democracy, 1865 to the Present. A continuation of History 91 with emphasis upon the emergence of contemporary problems in the United States. (Not open to freshmen.) One course. *Burgess, Cahow, Chafe, Davis, Durden, Gavins, Greeman, Holley, Nathans, and A. Scott*

ADVANCED HISTORY COURSES

Undergraduate Courses

101, 102. Introduction to the Civilizations of Southern Asia. (Also listed as Interdisciplinary Course 101, 102.)

103, 104. Renaissance and Reformation. Europe 1250-1600. Two courses. *Witt*

105, 106. Political and Constitutional History of England. The origins and evolution of the principal institutions of the English government, related to their setting in a changing society. Two courses. *Landau*

107, 108. Social and Cultural History of England. English history from the fourteenth century to the present time in an effort to arrive at a synthesis of ideas, social conditions, and political events and thus provide a background for the study of English literature. Two courses. *Ferguson*

111, 112. America in the Colonial and Early Modern Era. The history of America from the discovery to the beginning of the Civil War. Two courses. *Alden*

113, 114. The United States from the 1890's to World War II. First semester to 1920; second semester through the New Deal. Two courses. *Watson*

115, 116. History of Africa. Social, political, and economic development in tropical Africa. First semester: cultural background and precolonial history Second semester: colonial and contemporary times. Two courses. *Hartwig*

117, 118. European Imperialism and Colonialism. The age of discovery the new imperialism, and modernization of post-colonial societies. Two courses *Cell*

119, 120. History of Socialism and Communism. The origins and development of socialist and communist movements from pre-Marxian times to th present. Two courses. *Lerner*

121, 122. Diplomatic History of the United States. Emphasis on thos factors, foreign and domestic, that have shaped the foreign policies of the Republic Two courses. *Davis*

123, 124. City and Frontier in United States History. The westward movement and the progress of urbanization with attention to the social and politica consequences. Two courses. *A. Scott*

125. The Athenian Empire. (Also listed as Classical Studies 134.) On course. *Staff*

126. Alexander the Great. (Also listed as Classical Studies 135.) On course. *Staff*

127. History of Latin America through the Formation of the Nationa Governments. One course. *TePaske*

128. Inter-American Affairs. This course treats the relations of the Latin American states with each other and with the United States with the design of explaining the current significance of Latin America. Chief emphasis is placed upo social problems and movements common to all the republics and upon the role o the United States in Latin American affairs. One course.

129, 130. Society and Government in the United States 1789-1877. Tw courses. *Nathans*

131. Mexico and the Caribbean from the Wars of Independence to th Present. One course. *TePaske*

133, 134. Medieval History. Europe, 300-1500. Two courses. *Young*

135, 136. Europe in the Twentieth Century. Political, economic, and intellectual developments in Europe since 1900. First semester to 1933; secon semester to the present day. Two courses. *Colton*

137, 138. Foreign Relations of the European Powers. European diplomacy and Europe's position in the world since 1870, with an introductory surve of diplomatic institutions since the Renaissance. Two courses. *W. Scott*

139, 140. Nineteenth-Century Europe. With special attention to German and Austria-Hungary, this course emphasizes the development of European nationalism and the clash of freedom and authority. Two courses. *Hollyday*

141. Man and Society in Traditional China. Chinese thought and institutions from earliest times to the nineteenth century. One course. *Dirlik*

142. The Roots of the Revolution. Nineteenth and twentieth century China. One course. *Dirlik*

143, 144. History of Modern Japan. Japan from 1600 to the present; the transition from the traditional to the modern state. Two courses. *Silberman*

145, 146. Afro-American History. The Black experience in America from slavery to the present. Two courses. *Gavins*

147. History of India to 1707. Early development, classical Hindu civiliza-ion, the impact of Islam, first modern contacts. One course. *Embree and Sipe*

148. History of India and Pakistan, 1707 to the Present. Decay of the Mughal Empire, social and economic impact of Western rule, development of nationalism and independence. One course. *Embree and Sipe*

149. Military History. War, politics, and technology. (Also listed as Aero-pace Studies 102.) One course. *Hyatt and Ropp*

150S. The Concept of the Democratic Faith. One course. *Cahow*

151. Modern Technology. Emphasis on Western technology in the nine-eenth and twentieth centuries as related to political, economic, and scientific rends. One course. *Ropp*

152. Issues and Problems in Twentieth Century South America. Revolu-ion, national identity, myth and reality of caudilloism, imperialism, ideology left and right, and nationalism. Readings in English or Spanish. (Also listed as Ro-nance Languages 152.) One course. *Fein and TePaske*

155, 156. Major Nations of South America: Political, Economic, and Social Currents. Two courses. *Bergquist*

157, 158. The Rise of Modern Science. The development of science and nedicine, with attention to cultural and social influences upon science. First semes-er: through Newton. Second semester: eighteenth to twentieth centuries. Two ourses. *Mauskopf*

160. The United States from the New Deal to the Present. One course. *Chafe*

161, 162. History of Russia. From Kievan to Soviet Russia. An exploration nto the processes of social change. Two courses. *Miller*

163, 164. Reform and Politics in Nineteenth-Century United States. First semester: the coming of the Civil War, with emphasis on the reform move-ments of the Jackson era, the anti-slavery crusade, and national politics to 1861. Second semester: reform and politics from the War and Reconstruction era to the Farmers Revolt of the 1890's. Two courses. *Durden*

167, 168. Modern European Intellectual and Cultural History. Leading European thinkers from the Enlightenment to the present. Two courses. *Parker*

169, 170. The Search for the American Woman: A New Approach to Social History. Two courses. *A. Scott*

199. The Changing South. (Also listed as Interdisciplinary Course 199.)

For Upperclassmen and Graduates

Students may receive credit for either semester of a hyphenated course a the 200-level without taking the other semester if they obtain written permissio from the instructor and either the Director of Undergraduate Studies or th Director of Graduate Studies.

201-202. History of Russia, 1801-1917. Origins and dynamics of th Russian revolutionary movement, the intelligentsia, and the emergence of politica parties. Two courses. *Miller*

207-208. Urban History of the United States. Urbanization in the Unite States since the Colonial period. Each student is responsible for the history of particular city, with attention to the emerging methodology of urban studies. Tw courses. *A. Scott*

209-210. Selected Topics in Afro-American History, 1619-Present. Critica issues of the collective experience of Afro-Americans with special attention t Black institutional development. Two courses. *Gavins*

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of major issues in United States histor through examination of recent interpretations of key problems. (Open only to history graduate students and seniors doing practice teaching in one of their final tw semesters.) One course. *Watson and Staff*

215-216. The Diplomatic History of the United States. (Not open t undergraduates who have had History 121-122.) Two courses. *Davis*

219. Historical and Contemporary African Society. Identification o political, social, and economic themes. One course. *Hartwig*

221-222. Problems in the History of Late Medieval Europe and Earl Modern Europe. Two courses. *Witt*

223S-224S. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth and eighteenth centur Europe, with emphasis on France and the French Revolution. Two courses *Acomb*

227-228. Recent United States History: Major Political and Social Movements. Two courses. *Chafe*

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the stud and discussion of recent interpretations of key historical problems in modern European history. (Open only to history graduate students and seniors doing practic teaching in one of their final two semesters.) One course. *Parker*

230. History of Spain. Late medieval period to the present. One course *TePaske*

231-232. The Hispanic Colonies and Republics in America. First semester: the Spanish Conquest; the church, race, and society; universities, medicine and science. Second semester: the wars of independence, problems of land. education, and public health. Two courses. *TePaske*

233-234. The Institutional, Cultural, and Social History of Hispani America. Two courses. *TePaske*

237S-238S. Europe in the Middle Ages, 395-1500. Two courses. *Young*

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and musical and artistic traditions. One course. *Hartwig*

241-242. Modernization and Revolution in China Since 1850. Two courses.

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation, with special emphasis on social and economic change. One course. *Embree*

248. History of Modern India and Pakistan, 1857 to the Present. One course. *Embree*

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. Two courses. *Holley*

253-254. Modern European Intellectual History. Two courses. *Parker*

255S-256S. Problems in African History. Two courses. *Hartwig*

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. Two courses. *Lerner*

263-264. American Colonial History and the Revolution, 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. Two courses. *Alden*

265-266. Modern South America. Political, social, and economic history of the leading South American nations from the mid-nineteenth century to the present. Two courses. *TePaske*

267S-268S. From Medieval to Early Modern England. The intellectual, social, and political problems of transition to modern England, with special emphasis on the English Renaissance. Two courses. *Ferguson*

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class consciousness, Victorianism, and the impact of war in the twentieth century. Two courses. *Cell*

273, 274. Topics in the History of Science. Critical stages in the evolution of scientific thought. Two courses. *Mauskopf*

275S-276S. Central Europe, 1849-1914. Conflict between liberalism and authoritarianism, clash of nationalities, and domestic changes in Germany and Austria-Hungary. Two courses. *Hollyday*

277-278. The Era of the Civil War in the United States and its Aftermath, 1820-1900. Two courses. *Durden*

279. Oral History. Techniques applied to racial attitudes and problems in the United States. One course. *Goodwyn*

280. Historiography. One course. *Staff*

281S-282S. Development of Modern Medicine. Two courses. *Brieger*

283-284. Political and Social Change in the United States, 1789-1880. Two courses. *Nathans*

287-288. History of Modern Japan. The political, economic, and social development of Japan since 1750; factors contributing to Japan's emergence as a modern state. Two courses. *Silberman*

290. East African History. One course. *Hartwig*

296S. Canada from the French Settlement. Problems in the development of Canada and its provinces. One course. *Preston*

297. The British Empire in the Nineteenth Century. (From 1783.) The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. One course. *Preston*

298. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anticolonialism. One course. *Preston*

SMALL-GROUP LEARNING EXPERIENCES

(For discussion sections, see History 1D, 2D, 61D, 62D.)

Independent Study

Independent study is usually undertaken by students concurrently with a course or with an instructor with whom they have had a course. Students should submit to the instructor in writing a detailed general description of intent in the course. Both the instructor's consent and approval of the Director of Undergraduate Studies are required for enrollment.

191, 192. Independent Study. Directed reading and research. Two courses. *Staff*

193, 194. Independent Study. Same as 191, 192, but for seniors. One or two courses each. *Staff*

Undergraduate Seminars

(See also History 51S, 52S, 150S.)

165S-166S. Sophomore Seminar. Open to sophomores on application to the Director of Undergraduate Studies with permission of the instructor. Two courses.

The following seminars are designed to offer opportunities for reading and historical investigation in significant problems. Juniors as well as seniors may apply for admission to these courses, and are urged to do so if they expect to be candidates for Graduation with Distinction in History or if they expect to practice-teach in their senior year. All seminars are open to non-majors as well as to majors.

195A-196A. Renaissance Intellectual History. Studies in the transformation of European thought between 1300 and 1600. Two courses. *Witt*

195B-196B. Twentieth-Century Europe. Two courses. *Colton*

195C-196C. Problems in the Intellectual History of the United States. (Students may not receive credit for this course and History 249-250.) Two courses. *Holley*

195D-196D. Problems in Twentieth-Century United States History. Two courses. *Chafe and Watson*

195E-196E. The Age of the American Revolution. Two courses. *Alden*

195F-196F. The Era of the Civil War in the United States and its Aftermath, 1820-1900. (Students may not receive credit for this course and History 163-164.) Two courses. *Durden*

195G-196G. Nationalism and Communism in the Far East. Two courses. *Dirlik*

195H-196H. From Rural to Urban Society in the United States. Two courses. *A. Scott*

195I-196I. Nationalism and Freedom in Nineteenth-Century Europe. Two courses. *Hollyday*

195J-196J. Studies in the History of Socialism and Communism. Two courses. *Lerner*

195K-196K. Social Change in Modern Britain. Two courses. *Cell*

195L-196L. Europe in the Age of the Reformation, 1500-1650. Two courses.

195M-196M. Europe and the World since 1914. Two courses. *W. Scott*

195N-196N. The English Renaissance. Two courses. *Ferguson*

195P-196P. Social and Political Problems in English History, 1680-1815. Two courses. *Landau*

195R-196R. The Age of Newton. Two courses. *Mauskopf*

195S-196S. Processes of Development in Modern Japan, 1800 to the Present. Two courses. *Silberman*

195T-196T. Problems in the History of Russia Before 1917. Two courses. *Lerner and Miller*

195U-196U. Social Conflict and Political Change in the United States, 1789-1860. Two courses. *Nathans*

195V-196V. Problems in Afro-American History. Two courses. *Gavins*

195W-196W. Studies in Modern Indian History. Two courses. *Embree*

195X-196X. Problems in Latin American History. Two courses. *Bergquist*

195Y-196Y. Issues in the History of Tropical Africa before 1900. Two courses. *Hartwig*

195Z-196Z. Problems in Recent United States Diplomatic History. Two courses. *Davis*

196.99 History Honors Pro-Seminar. Required in the spring semester of juniors selected for the Senior Honors Seminar of the following year. Conferences on selection of research topics and research techniques. Half-course. *Cell, Holley, and Parker*

197-198. Senior Honors Seminar. A course designated to introduce qualified students to advanced methods of historical research and writing and to the appraisal of critical historical issues. Open only to seniors, but not restricted to candidates for degree with distinction. This course, when taken by a history major, would be in addition to the two courses required in 195-196 seminars or 200-level courses of the History Department. Two courses. *Cell, Holley, and Parker*

Upperclassmen-Graduate Seminars

(See History 223S-224S, 237S-238S, 255S-256S, 267S-268S, 275S-278S, 281S-282S, and 296S.)

DEPARTMENTAL MAJOR

Prerequisite. Two introductory courses in history (1D-2D, 51-52, 51S-52S, 53-54, 61D-62D, 91-92).

Major Requirements. Students desiring to take a major in history are required to elect, in addition to the two prerequisite courses, six courses in the department, including two courses in either an undergraduate seminar (195-196) or any two courses on the 200-level. Students wishing to take the more advanced courses in American history are advised to elect History 91-92 in the sophomore or junior year.

Foreign Languages. Majors interested in a particular area of study would benefit from knowledge of the language of that area. Majors who contemplate graduate work are reminded of the requirement of a reading knowledge of one or two foreign languages.

Majors Planning to Teach. Majors who plan to teach in secondary schools should consult the Education Department. Rising juniors who intend to do practice teaching in their senior year should take their 195-196 seminar or 200-level course as juniors. Two courses, History 229 in the fall and 212 in the spring, are scheduled in accelerated sessions to fit the half semester the student is on campus during the semester he does practice teaching.

Ancient History. For other courses in ancient history which may be taken for credit in history or classical studies, see the history courses listed under classical studies.

Honors. Any student who is qualified (see the section on Honors in this *Bulletin* for general requirements) may undertake work leading to a degree with distinction in history by presenting himself to his history faculty adviser as a candidate. Normally, honors work involves participation in one of the 195-196 seminars during the junior year and selection for the Senior Honors Seminar in the senior year. Further information is available at the History Department office, 236 Allen, West Campus, or 102 West Duke Bldg., East Campus.

House Courses

See page 39 for information about house courses. Since each house course is offered one time only they are not listed or described here.

Interdisciplinary Courses

The following are cooperative courses offered by the departments concerned. Where a department accepts the course for the major, the same number is used as a departmental offering.

101, 102. Introduction to the Civilizations of Southern Asia. Hindu, Islamic, and Buddhist foundations, impact of the West, and emergence of the modern nation-states of Southern Asia. The first semester will analyze traditional Hindu civilization and the Islamic impact on Southern Asia. The second semester will examine Western influences and the development of modern societies and states in Southern Asia. Two courses. *Apte, Braibanti, Embree, Fox, McCormack, Spengler, and Tangri*

104. Man and the Marine Environment. For description see Marine Sciences.

109. Themes in Contemporary Jewish Thought. Religious, social, and political issues confronting the contemporary Jew in the United States. Half-course. *Meyers*

156. The Contemporary Woman: History and Prospects. A survey of the status of women with consideration of cultural, sociological, psychological, and political aspects. Half-course. *Carson, Quinn, and Simpson*

158. Women and Literature. Small-group discussions of modern women authors including Virginia Woolf, Doris Lessing, and Anais Nin, and of myths of women in literature and society. Nature of course adapted to the interests of students. This course may be used for distributional requirements in humanities. Prerequisite: permission of the instructor. One course. *Alstad*

167S. Ecology and Social Action. An introductory survey of the ecosystem and its problems; consideration of political and social solutions to them. One course. (See the Departments of Botany and Political Science.) *Strain and Leach*

199. The Changing South. A survey of the geography, demography, economics, politics, and culture of the South. (See the Departments of Anthropology, Economics, History, Political Science, and Sociology.) One course.

Italian

For courses offered in Italian, see *Romance Languages.*

Latin

For courses offered in Latin, see *Classical Studies.*

Linguistics

The courses in linguistics may be taken as electives by advanced students; certain courses serve as related work in several departments (see the entries for related work under the separate departments).

No major is offered in linguistics. Students interested in the study of language as part of their undergraduate program or as a preparation for graduate work in linguistics should consult the instructors of the courses listed below.

For a description of the following courses consult the listings under the specified department.

Introduction to Linguistics. (English 107.) *Butters, Casson, and Hull*

Language, Culture, and Society. (Anthropology 119.) *Apte*

Indo-Aryan Linguistics. (Anthropology 240S.) *Apte*

Linguistic Anthropology: Language Acquisition. (Anthropology 259S.)

Linguistic Anthropology: Phonemics. (Anthropology 260S.)

Linguistic Anthropology: Morphology and Syntax. (Anthropology 261S.)

Development of the English Language. (English 108.) *Butters*

Modern English Grammar. (English 109.) *Butters*

Old English Grammar and Readings. (English 207.) *Nygard*

History of the English Language. (English 208.) *Nygard*

Present-Day English. (English 209.) *Butters, Nygard, and Reiss*

The Structure of French. (French 210.) *Hull*

Old French Literature. (French 219.) *Vincent*

History of the French Language. (French 224.) *Hull*

Dutch. (German 181, 182.) *Stern*

Middle High German. (German 205, 206.) *Stern*

History of the German Language. (German 216.) *Stern*

Applied Linguistics. (German 219.) *Stern*

Symbolic Logic. (Philosophy 103.)

Philosophy of Language. (Philosophy 109.) *Welsh*

Old Spanish Languages. (Spanish 257.) *Davis*

Management Sciences

Professor Volpp, *Chairman;* Assistant Professor Kuhn, *Director of Undergraduate Studies;* Professors Baligh, Black, Dickens, Joerg, and Keller; Associate Professors Battle, Burton, Dellinger, Laughhunn, and Pondy; Assistant Professors Aldrich, Damon, Hagerman, Maier, Petersen, Vander Weide, and Vaupel

The courses offered by the Department of Management Sciences stress conceptual understanding of, and analytical reasoning related to, problems of modern management, and the relationship between the performance of complex organizations and the society in which they operate.

50. Elementary Theory of Economic Enterprise. Analysis of the internal resource allocation problem of the enterprise, of market structures, and the relationship between the two. Topics include marginal analysis, theories of competitive market structures, and introduction to special problems of finance, marketing, and production. Prerequisite or corequisite: Math 32. One course.

50P. Preceptorial. Elective preceptorial for students enrolled in Management Sciences 50. *Staff*

55. Quantitative Analysis for Management. Some mathematical theory and techniques used in the study of economic enterprise, such as classical optimization, optimization under constraints, introductory matrix and linear algebra, basic probability theory, special probability distributions. Not open to students who have had Economics 54, Mathematics 73, or Mathematics 135. Prerequisite: Math 31. One course.

100. Introduction to Financial Accounting. Conceptual framework of external reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economic terms and the interpretation of published financial statements. Prerequisite: sophomore standing. One course.

110. Statistics for Management Decisions. Fundamentals of classical and Bayesian statistical analysis and elementary decision theory. Application of statistical analysis to decision problems. Topics include a review of sampling distributions, point and interval estimation, hypothesis testing, decision theory, and regression and correlation analysis (including computer routines). Not open to students who have had Management Sciences 60, Economics 138, or Mathematics 136. Prerequisites: Management Sciences 55, Mathematics 135, or Economics 54. One course.

111. Investment Management. Problems of selecting a portfolio of investments emphasizing the economics of the markets and the tools of analysis. Prerequisites: Management Sciences 50 and 110 or equivalents, or consent of the instructor. One course.

120. Organization Theory. Introduction to recent theories of, and research on, the structure and behavior of complex organizations, with special reference to business firms. Topics to be covered include: rationality, authority, bureaucracy, and other concepts; power, decision-making, informal organization, organization change, and other internal process phenomena; effects of technology, culture, and other environmental influences; brief consideration of organization design. Prerequisites: Management Sciences 50, 55 or equivalent. One course.

125. Management of Public Enterprises. Resource allocation within and among major public sector projects in a mixed economy. Emphasis on non-market decision-making for governmental agencies and other non-profit organizations. Prerequisite: junior standing or Management Sciences 50 or Economics 52. One course.

130. Information Systems. An analysis of the data needed for economic decisions relating to business enterprises and of the systems used in accumulating, analyzing, interpreting, and presenting the data to various users. Financial reporting to external users and managerial use of information for decision-making are stressed. Prerequisites: Management Sciences 50, 55, or equivalent. One course.

140. Operations Research. Introduction to the use of mathematical models in the analysis of decision problems. Topics include mathematical programming, game theory, dynamic programming, queuing theory, simulation, and inventory models. Use of electronic computer will be included. Prerequisites: Management Sciences 50, 55, or equivalent, and computer programming competence. One course.

191, 192. Independent Study. Directed reading and research. Approval of the instructor and the Director of Undergraduate Studies required.

193, 194. Independent Study. Same as 191, 192 but for seniors.

210S. Intermediate Theory of Economic Enterprise. Introduction to competitive market strategies and cooperating decisions and analysis of the efficiency and equilibrium of market structures. Emphasis is on the effects of the economic environment on the decision of the enterprise, and conversely. Prerequisites: Management Sciences 120, 130, and 140. One course.

211S. Finance. An analysis of the problems of management of the financial affairs of the firm with particular attention to the long-term capital needs and the development of an optimal capital structure. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

213S. Marketing. An examination of public policy and the marketing behavior of private enterprise and the creation of a marketing program for the firm Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

215S. Production. An economic and social analysis of the problems of designing a production system for an organization, of operating within the constraints of a given production system, and of the interactions between a production system and other components of the organization and with society. Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

220S. Advanced Organization Theory. Continuation of Management Sciences 120S, but with extension to non-market organizations such as labor unions universities, hospitals, and governmental units. Special emphasis will be placed on the following topics: development and testing of mathematical models of organization; optimum organization design; treatment of organization as political coalitions, using game theoretic concepts; consideration of the social choice questions Prerequisites: Management Sciences 120, 130, and 140, or permission. One course

230S. Controllership. An analysis of the use of accounting information in the planning, control, and decision-making process in the business enterprise. Topics include methods of cost accumulation, development of standards, the basic patterns of cost behavior, budgeting techniques for aiding long-range planning and the making of specific decisions. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

231S. Financial Accounting. An in-depth analysis of the requirements of outsiders (investors, auditors, unions, and governments) for information about the status and operations of firms and a framework for disclosure of the relevant data Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

232S. Internal Control and Auditing. An analysis of the accounting control system and the independent auditor's examination of that system and other evidence as a basis for expressing an opinion on a client's financial statements. Topics include basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Sciences 110 and 231, or permission. One course.

233S. Federal Income Taxation. A study of the principles of federal income tax laws as related to corporations and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite: Management Sciences 231 or permission. One course.

234, 235, 236. CPA Preparation. Intensive preparation for the Certified Public Accountant's Examination, including fundamental principles of commercial law, advanced accounting problems, and accounting theory. Prerequisites: Management Sciences 230 and 231 or permission. (Those who do not wish credit may take Management Sciences 234, 236 for $40.00 per semester.) One course each.

240S. Advanced Operations Research. The application of operations research methodology to real world problems. Special emphasis will be placed on problem formulation, model-building, model validation and evaluation, sensitivity analysis, interpretation of results, and implementation. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

241S. Decision Theory. A study of the structure of decision problems arising in the operation of an organization, alternative decision criteria, and the development of decision rules for rational behavior. Included will be an investigation of decision-making under certainty, risk, and uncertainty, decision-making in competitive situations, and the cost and value of information. Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

289S. Research Methodology. Philosophy and logic of research in the social sciences (nature of explanation; normative and positive theories; functional, rational, and conflict models); theory development and model construction (including attention to testability of inferences, problems of identification, etc.); experimental design, data collection, and data analysis (including attention to problems of uncontrolled experiments, sampling theory, comparison of case studies, survey research, field experiments, use of published data). Prerequisites for management sciences majors: Management Sciences 120, 130, and 140. For nonbusiness majors; one semester of statistics, computer programming, one upper-level mathematics course, and at least three social science courses beyond the introductory level. One course.

DEPARTMENTAL MAJOR

The Department of Management Sciences offers specialization in two areas—accounting and management science. Each program requires that the student take the same prerequisite courses.

Prerequisites and corequisites required of all majors in the department; Mathematics 31, 32.

Required Courses. Management Sciences 50, 55, 110, 120, 130, 140, and 210, plus one elective from 200-level courses. The elective work required for specialization in accounting includes Management Sciences 230, 231, 232, and 233.

Marine Sciences—The University Program

Professor Costlow, *Director;* Professors Bookhout (Zoology) and Johnson* (Botany); Associate Professors Barber (Zoology), Pilkey* (Geology), and Searles* (Botany); Assistant Professors Baier (Chemistry), Gutknecht (Physiology), Sullivan (Biochemistry), Sutherland (Zoology), and Forward (Zoology)

The interdisciplinary program in the marine sciences makes it possible for qualified juniors and seniors to live and study at the Duke University Marine Laboratory, Beaufort, North Carolina, during the spring term. The semester program consists of two courses (104 and 150 or 169) and a seminar, in addition to independent research. The design of the program permits a student to continu study at the Marine Laboratory during the summer either by participating i senior-graduate courses or by continuing the independent studies initiated durin the spring term.

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*In residence during summer only.

Applications are to be submitted by October 7 to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516, and should includ two letters of recommendation, one of which must be from the director of undergraduate studies of the student's major department. A current transcript is also required. The review committee will be composed of the Director of the Laborator and the directors of undergraduate studies of the participating departments. Students will be notified of the action of the committee prior to registration for th spring semester.

104. Man and the Marine Environment. Economic, legal, medical, political social, and scientific viewpoints on the extent to which modern society has affecte the marine environment with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisite: permission of instructor and directo of undergraduate studies of student's major department. (Listed as Interdisciplinar Course 104). One course. *Costlow and Staff*

150L. Physiology of Marine Organisms. Comparative studies including special ecological and behavioral adaptations. Lectures and laboratories. A studen may not receive credit for both Zoology 150L and 250L. Prerequisites: colleg biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. (Listed as Zoology 150L.) One course. *Forwar*

169L. The Marine Environment. The interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisites: introductory chemistry and consent of instructor and director of undergraduate studies. (Listed as Botany 169, Geology 169, and Zoology 169.) One course. *Sutherland and Staff*

171S. Marine Sciences Seminar. Lectures and discussions on current research involving biological, chemical, and geological aspects of estuarine and oceanic environments. Prerequisite: permission of instructor and director of undergraduate studies. (Listed as Botany 171, Geology 171, and Zoology 171.) Half-course. *Barber and Staff*

296S. Seminar. Topics, instructors and course credits announced each semester. (Listed as Zoology 296S.) *Staff*

Independent Study or Special Problems (credit value of one and one-half courses) are to be registered for under the appropriate course numbers of the student's major department.

For Seniors and Graduates

For descriptions of the following summer courses consult the listings under the specified departments of the *Bulletin of the Duke University Marine Laboratory.*

S202. Introduction to Comparative Behavior. (Listed as Zoology 202.) Two courses. *Salmon*

S203. Marine Ecology. (Listed as Zoology 203). Two courses. *Sutherland*

S205. Geological Oceanography. (Listed as Geology 205). Two courses. *Pilkey*

S205. Introductory Marine Microbiology. (Listed as Botany 205). Two courses. *Searles and Johnson*

S211. Marine Phycology. (Listed as Botany 211). Two courses. *Searles*

S212. Marine Membrane Physiology. (Listed as Physiology 212 and Zoology 212L.) Two courses. *Gutknecht, Schoffeniels, Wachtel, and Staff*

S214. Biological Oceanography. (Listed as Zoology 214). Two courses. *Barber*

S240. Chemical Oceanography. (Listed as Chemistry 240 and Zoology 240). Two courses. *Baier*

S250. Physiological Ecology of Marine Animals. (Listed as Zoology 250). Two courses. *Staff*

S274. Marine Invertebrate Zoology. (Listed as Zoology 274). Two courses. *Staff*

S276. Comparative and Evolutionary Biochemistry. (Listed as Biochemistry 276 and Zoology 276). Two courses. *Sullivan*

S277. Endocrinology of Marine Animals. (Listed as Zoology 277.) Two courses. *Hagadorn*

S278. Invertebrate Embryology. (Listed as Zoology 278). Two courses. *Bookhout*

Mathematics

Professor Shoenfield, *Chairman;* Associate Professor Hodel, *Director of Undergraduate Studies;* Associate Professor Kitchen, *Supervisor of Freshman Instruction;* Professors Carlitz, Dressel, Murray, Warner, and Weisfeld; Associate Professors Burdick, Moore, Scoville, Smith, and Stackelberg; Assistant Professors Henson, Herr, Kraines, Lees, MacKichan, O'Fallon, Wilkinson, and Wong; Visiting Assistant Professor Cochrane; Instructors Katz, Lada, and Smith

17. Introduction to Finite Mathematics. A course designed to introduce students to some of the concepts in modern mathematics. Elementary logic, sets and subsets, vectors and matrices, and probability theory are studied. Some applications of these topics to the biological, social, and physical sciences are considered. Prerequisite: three units of college preparatory mathematics. One course. *Staff*

31, 32. Introductory Mathematical Analysis. Language of logic and sets, elementary and transcendental functions, continuity, differentiation, integration, the fundamental theorem of the calculus, sequences, series, Taylor's formula. Prerequisite: three units of college preparatory mathematics. Mathematics 31 is prerequisite to Mathematics 32. Two courses. *Staff*

31P, 32P. Preceptorial. Elective preceptorial for students enrolled in Mathematics 31, 32. *Staff*

31X, 32X. Honors Calculus. Similar to Mathematics 31, 32 but more theoretical. Majors in mathematics as well as others who have Achievement Test

Scores of 760-800 are encouraged to enroll. Occasionally these courses will be offered as seminars. Two courses. *Kitchen*

51. Introduction to Digital Computation. For a description of the course, see Computer Science 51. One course. *Gallie*

53. Basic Statistics. Statistical concepts involved in making inferences, decisions, and predictions from data. Techniques not emphasized. Not open to students who have had Economics 138 or Psychology 117. One course. *Wilkinson*

68. Introduction to Linear Algebra. A basic course in the geometry of vectors in Euclidean n-space, real vector spaces, simultaneous equations, linear transformations and matrix representation, elementary row operations, equivalence and similarity of matrices, determinants, and quadratic forms. Prerequisite: Mathematics 17 or 31. One course. *Staff*

101, 102. Linear Algebra and Intermediate Mathematical Analysis. Real and complex vector spaces, linear transformations and matrix representations, similarity of matrices, determinants, quadratic forms, partial differentiation, functions defined implicitly, multiple integrals, infinite series, linear differential equations. Prerequisite: Mathematics 32 for 101, and Mathematics 101 for 102. Two courses. *Staff*

101P, 102P. Preceptorial. Elective preceptorial for students enrolled in Mathematics 101, 102. *Staff*

111. Applied Mathematical Analysis I. Ordinary and partial linear differential equations with constant coefficients, Fourier series and their applications, vectors. Not open to students who have had Mathematics 131. Prerequisite: Mathematics 102. One course. *Staff*

112. Applied Mathematical Analysis II. Complex variables, residues, conformal mapping, matrices, Laplace and Fourier Transforms and their applications. Prerequisite: Mathematics 102. One course. *Staff*

126. Introduction to Linear Programming and Game Theory. Fundamental properties of linear programs; linear inequalities and convex sets; primal simplex method; duality; two person and matrix games; integer programming. Prerequisites: Mathematics 32 and 68 or 101 or consent of the instructor. One course. *Weisfeld*

128. Number Theory. Divisibility properties of integers; prime numbers; congruences; quadratic reciprocity; number-theoretic functions; simple continued fractions; rational approximations. Prerequisite: Mathematics 32 or permission of instructor. One course. *Staff*

129. Introduction to Modern Algebra. Elementary theory of groups, rings, and fields; construction of basic number systems. Prerequisite: Mathematics 68 or 101. One course. *Staff*

131. Elementary Differential Equations. Solution of differential equations of elementary types; formation and integration of equations arising in applications. Not open to students who have had Mathematics 111. Prerequisite: Mathematics 102. One course. *Staff*

135, 136. Probability and Statistics. Permutations and combinations, total and compound probability, Bayes' formula, Bernoulli's theorem, discrete distributions, central values, moments and mathematical expectation, law of large numbers, probabilities in continuum, continuous distributions, sampling distributions, confidence limits, tests of hypotheses, and analysis of variance. Prerequisite: Mathematics 102 for 135; 135 for 136. Two courses. *Burdick*

135P, 136P. Preceptorial. Elective preceptorials for students enrolled in Mathematics 135, 136. *Burdick*

139, 140. Advanced Calculus. Differential and integral calculus of functions of several variables; spaces of continuous functions; Fourier series; existence theorems and uniqueness theorems for differential equations; line and surface integrals; Green's theorem and Stokes' theorem; power series and analytic functions. Prerequisite: Mathematics 102 for 139; and 139 for 140. Two courses. *Staff*

152. List Processing and Data Structures. For a description of this course, see Computer Science 152. One course. *Staff*

161. Numerical Solution of Ordinary Differential Equations. Basic existence and uniqueness considerations; algorithmic procedures for step by step integration; stability theory and its limitations; accuracy analysis and numerical procedures for determining it; analogue methods and their accuracy and stability characteristics. Prerequisite: Mathematics 102. One course. *Murray*

166. Foundations of Applied Mathematics. Intellectual basis of applied mathematics and its relationship with the historical development of epistemological theory. Criteria of validity and consistency as applied to the logical tools of linguistics, symbolism, abstraction, gaming, and simulation. Prerequisite: Mathematics 102. One course. *Murray*

171S. Elementary Topology. Basic set theory; metric spaces; topological spaces; continuity; basic topological properties including compactness and connectedness. Prerequisite: Mathematics 102. One course. *Staff*

181. Complex Analysis. Complex numbers, analytic functions, complex integration, Cauchy's theorem, Taylor and Laurent series, theory of residues, argument and maximum principles, conformal mapping. Prerequisite: Mathematics 102. One course. *Staff*

183. Introduction to Statistical Methods. Emphasis on the classical techniques of hypothesis testing and point and interval estimation, using the binomial, normal, t, F, and chi-square distributions. Prerequisite: Mathematics 32 or consent of the instructor. One course. *Wilkinson*

187. Introduction to Mathematical Logic. Propositional calculus, predicate calculus, Godel completeness theorem, applications to formal number theory, incompleteness theorem, additional topics in proof theory or computability. Prerequisites: Mathematics 68, or 102, or Philosophy 103. One course. *Henson*

191, 192. Independent Study. Directed reading and research. Admission by approval of instructor and Director of Undergraduate Studies. Two courses. *Staff*

193, 194. Independent Study. Same as 191, 192, but for seniors. Two courses. *Staff*

197S. Seminar in Mathematics. Primarily intended for juniors and seniors majoring in mathematics. Content of course determined by instructor. Prerequisite: Mathematics 102. One course. *Staff*

For Seniors and Graduates

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry, and an algebraic model of Euclidean geometry. One course. *Staff*

206. Introduction to Stochastic Processes. Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. One course. *Wilkinson*

207, 208. Introduction to Algebraic Structures. Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prerequisites: Mathematics 68 or 101 for 207; and 207 for 208. Two courses. *Staff*

217, 218. Intermediate Analysis. Elementary point set topology and differential calculus in n-space; implicit and inverse function theorems; integration theory; differentiable manifolds; differential forms; generalized Stokes' theorem. Prerequisite: Mathematics 102 for 217; and 217 for 218. Two courses. *Staff*

221, 222, 223. Numerical Analysis. For a description of these courses, see Computer Science 221, 222, 223. Three courses. *Patrick*

227, 228. Theory of Numbers. Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisites: Mathematics 102 for 227; and 227 for 228. Two courses. *Carlitz*

229, 230. Algebraic Numbers. Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisites: Mathematics 207 for 229; and 229 for 230. Two courses. *Carlitz*

234. Sample Designs. Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multistage sampling; methods of estimation; questionnaire construction; refusal and not-at-homes. Prerequisite: Mathematics 183. One course. *Staff*

235, 236. Algebra. Elementary categorical algebra; groups with operators, G-sets, structure groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. Two courses. *Staff*

244. Analysis of Variance. Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. One course. *O'Fallon*

245, 246. Combinatorial Analysis. Generating functions, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. Two courses. *Carlitz*

247, 248. Arithmetic of Polynomials. Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisites: Mathematics 207 or consent of the instructor for 247; and 247 for 248. Two courses. *Carlitz*

260. Design of Experiments. Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. One course. *Burdick*

262. Non-Parametric Statistics. A study of statistical tests in which no assumption about the underlying distribution is made; single and multiple sample tests for nomial and ordinal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 136 or consent of the instructor. One course. *Staff*

265, 266. Homological Algebra and its Applications. Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. Two courses. *Weisfeld*

271, 272. Introductory Topology. Basic topological properties, including compactness, connectedness, and metrizability; product spaces and function spaces; introduction to algebraic topology. Prerequisite: Mathematics 102 for 271; and 271 for 272. Two courses. *Staff*

273, 274. Algebraic Topology. Homology and cohomology theories; complexes; introduction to homotopy groups, Cech homology theory. Prerequisite: Mathematics 272. Two courses. *Kraines*

275, 276. Probability. Foundations of probability; random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisite: Mathematics 135; or calculus and consent of the instructor. Two courses. *Staff*

283. Applied Mathematical Statistics. Basic probability concepts, the sample space, discrete and continuous events, permutations and combinations, conditional and marginal probability, discrete and continuous distributions, excepted values and moments, sampling distributions, estimation, hypothesis testing, confidence intervals, basic queuing theory. Prerequisite: Mathematics 102. One course. *Herr*

284. Least Squares Analysis of Linear Models. General linear models; geometrical interpretations; multiple regression; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to non-linear models. Prerequisite: Mathematics 136. One course. *Burdick*

285. Applied Mathematical Methods I. Vectors, line and surface integrals, tensors, complex variables, differential and integral equations. Prerequisite: Mathematics 102. One course. *Dressel*

286. Applied Mathematical Methods II. Wave equation, Fourier series, heat equation, telegraphic equations, Legendre polynomials, Bessel functions, Schrödinger's equation. Prerequisite: Mathematics 102. One course. *Dressel*

287, 288. Foundations of Mathematics. Propositional calculus, predicate calculus, axiomatized number theory. Godel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103, or consent of the instructor. Two courses. *Staff*

290. Stochastic Processes. Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. One course. *Wilkinson*

291, 292. Analysis I, II. Measure and integration theory; introduction to functional analysis; theory of analytic functions. Prerequisite: Mathematics 218 or 140, or consent of the instructor. Two courses. *Staff*

293. Multivariate Statistics. Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's T^2 statistic and the Roy union-interesection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284, or consent of the instructor. One course. *O'Fallon*

295. Mathematical Foundations of Statistical Inference. Inference-theoretic approach to hypothesis testing, decision making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful tests; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275, or consent of the instructor. One course. *Herr*

297, 298. Axiomatic Set Theory. Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of the instructor. Two courses. *Shoenfield*

DEPARTMENTAL MAJOR

Prerequisites. Mathematics 31, 32.

Major Requirements. Mathematics 101, 102, and six additional courses in mathematics numbered above 100 which must include one of the following year sequences: Mathematics 139, 140; Mathematics 207, 208; or Mathematics 217, 218. Mathematics 183 and 244 may not be counted among the six courses, and at most two of the following four courses may be counted: 152, 221, 222, 223.

It is recommended that all majors take a one year sequence in a natural science other than mathematics. For a student considering graduate study in mathematics, a reading knowledge of two foreign languages (usually either French, German, or Russian) is extremely desirable.

Medicine, School of—Basic Science Courses Open to Undergraduates

An undergraduate student in arts and sciences may select courses from the following offered by graduate departments associated with the School of Medicine, provided he has adequate preparation. For courses that are listed but not described below, see the *Bulletin of the Graduate School* for descriptions. If no prerequisites are listed, permission of the instructor is required. A major is not offered to undergraduates in any of the departments listed below.

For permission to work on courses listed below, and for further information, see Assistant Professor Cartmill, consultant for Anatomy; Assistant Professor Richardson, consultant for Biochemistry; Assistant Professor Luftig, consultant for Microbiology and Immunology; and Assistant Professor Gutknecht, consultant for Physiology and Pharmacology.

ANATOMY

151. Anatomy of the Lower Extremities as It Relates to Locomotion. Dissection of the human adult lower extremity. Demonstration and discussion of gait, biomechanics, and kinesiology. One course. *Bassett*

210. Introduction to the Human Structure. One or two courses by arrangement. *Shafland*

231. Human Evolution I. (Listed also as Zoology 131 and Anthropology 231.) Prerequisite: a course in biology or consent of instructor(s). One course. *Buettner-Janusch and Cartmill*

232. Human Evolution II. (Listed also as Zoology 132 and Anthropology 232.) Prerequisite: Anatomy 231 (Anthropology 231, Zoology 131) a course in genetics, or consent of instructor. One course. *Buettner-Janusch*

236. Human Genetics. (Listed also as Zoology 236 and Anthropology 236.) Prerequisites: Anatomy 231 (Anthropology 231, Zoology 131), or an elementary course in biology including genetics, or permission of instructor. One course. *Buettner-Janusch*

264. Mammalian Embryology and Developmental Anatomy. Prerequisites: one year of zoology and consent of instructor. One course. *Duke*

280. Molecular Basis of Anatomy. Prerequisites: microscopic anatomy or cytology (or equivalent) and permission of instructor. One course. *Adelman, Erickson, Longley, Moses, Reedy, and Robertson*

The following courses in anatomy are also available and are described in the *Bulletin of the Graduate School:* full courses—233-234, 271, 286, 288, 290, 291; half-courses—244, 261, 263; half to full course by arrangement—284.

BIOCHEMISTRY

209-210. Independent Study. A tutorial, based upon a laboratory or library project in biochemistry. One or two courses by arrangement. *Staff*

216. Molecular Genetics. Prerequisites: introductory courses in biochemistry and genetics. One course. *Guild and Staff*

247. Introductory Biochemistry. Prerequisites: Chemistry 151, one year of college physics (second semester may be concurrent), Mathematics 32, or consent of the instructors. (Listed also as Zoology 248.) One course. *Sage and Webster*

276. Comparative and Evolutionary Biochemistry. (Listed also as Zoology 276.) Two courses. (Given at Beaufort.) *Sullivan*

293. Macromolecules. Prerequisites: physical chemistry equivalent to Chemistry 161-162. One course. *Hill, Kim, Richardson, and Tanford*

295. Enzyme Mechanisms. One course. *Fridovich and Rajagopalan*

297. Intermediary Metabolism. One course. *Kirshner and Siegel*

298. Regulation of Cellular Metabolism. Prerequisites: Biochemistry 295, 297. Half-course. *Greene and Staff*

The following courses in biochemistry are also available and are describe in the *Bulletin of the Graduate School:* full courses—204, 219, 294; half-courses—208, 222, 282, 284, 288, 290, 296.

MICROBIOLOGY AND IMMUNOLOGY

215. Bacteriophage: Structure and Function. Half-course. *Luftig an Nichols*

221. Medical Microbiology. Prerequisite: consent of instructor. On course. *Joklik and Staff*

221L. Medical Microbiology. Prerequisite: consent of the instructor. On and one-half courses. *Joklik and Staff*

252. General Animal Virology and Viral Oncology. Prerequisite: consen of instructor. One course. *Joklik, Smith, and Zweerink*

282. Molecular Microbiology. Prerequisite: Microbiology 233 or consen of instructor. One course. *Burns, Nichols, Vanaman, Wheat, and Willett*

291-292. Immunology I and II. Two courses. *Staff*

PHYSIOLOGY AND PHARMACOLOGY

200. Physiology of Man. Two courses. *Staff*

208. Respiratory System in Health and Disease. Half-course. *Kylstra Saltzman, and Salzano*

209. Neuronal Physiology and Pharmacology. One course. *Narahash and Staff*

212. Marine Membrane Physiology. Given at Beaufort. Two courses. *Gutknecht, Schoffeniels, Wachtel, and Staff*

213. Cellular and Chemical Pharmacology. One course. *Ottolenghi and Staff*

215. Topics in Development Physiology and Pharmacology. Half-course. *Lieberman, Mendell, and Padilla*

216. Contractile Processes in Physiology and Pharmacology. One course. *Anderson, Jöbsis, and Johnson*

217. Membrane Transport Processes in Physiology and Pharmacology Half-course. *Gunn, Gutknecht, Kirk, Lauf, McManus, and Tosteson*

The following courses in physiology and pharmacology are also available and are described in the *Bulletin of the Graduate School:* full courses—201, 210-211: half-courses—279, 280; two-courses—200.

Medieval and Renaissance Studies Program

Professor Covi, *Chairman of the Committee on Medieval and Renaissance Studie*

The Program in Medieval and Renaissance Studies, an interdisciplinary major, is designed to provide the student with a well-rounded understanding of the historical, cultural, and social forces that shaped the Medieval and Renaissance periods. The program is divided into four areas of study: fine arts (Art and Music); history; language and literature (French, German, Greek, Italian, Latin, and Spanish); and philosophy-religion.

A major in this program consist of at least eight courses drawn from the non-introductory courses among the four areas of study, including three courses n each of two areas. Besides the courses specifically listed (under departmental headings) in the Medieval and Renaissance periods, provision may be made for ndependent study in any of the four areas. Each student's program is tailored to his interests and needs under the supervision of a committee consisting of faculty members from appropriate departments.

After discussion with the Chairman of the Committee for Medieval and Renaissance Studies, the student submits a provisional program of study outlining pecial interdisciplinary interests. Normally the student should plan his program well before the end of the sophomore year since he needs to acquire a working knowledge of languages pertinent to his interests.

The courses listed below are among those now available for the fulfillment of he major prerequisites and requirements. For a description of the courses consult istings under the specified department.

DEPARTMENT OF ART

133. Mediaeval Architecture. *Sunderland*
134. Mediaeval Painting and Sculpture. *Sunderland*
135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries. *Mueller*
137, 138. Italian Renaissance Art. *Jenkins*
140. Seventeenth Century Painting and Sculpture in Europe. *Jenkins*
144. Renaissance and Baroque Architecture. *Sunderland*
233. Early Mediaeval Architecture. *Sunderland*
234. Romanesque Sculpture. *Sunderland*
237. French Renaissance Art. *Jenkins*
238. Sienese Painting. *Jenkins*
248. Florentine Painting During the Renaissance. *Covi*
253S. Studies in Italian Renaissance Sculpture. *Covi*
255S, 256S. Iconological Problems. *Langedijk*

DEPARTMENT OF CLASSICAL STUDIES

Latin

87, 88. Sight Reading in Classical, Mediaeval, and Renaissance Latin. *Staff*
221. Mediaeval Latin I. *Newton*
222. Mediaeval Latin II. *Newton*

Classical Studies

Seminar in Byzantine History. *Rigsby*
117. Ancient Mythographers. *Newton*

DEPARTMENT OF ENGLISH

112. English Literature of the Middle Ages. *Reiss*
115. Chaucer. *Adams, Nygard, and Reiss*
121. English Literature of the Sixteenth Century. *DeNeef and Krueger*

123, 124. Shakespeare. *Krueger, Randall, and Williams*

125. English Literature of the Early Seventeenth Century. *DeNeef an Krueger*

127. Milton. *Lievsay and Price*

207, 208. History of the English Language. *Nygard and Reiss*

210. Old English Literary Tradition. *Nygard and Reiss*

212. Middle English Literary Tradition. *Nygard and Reiss*

215. Chaucer. *Nygard and Reiss*

216. Chaucer. *Nygard and Reiss*

221. English Prose of the Sixteenth Century. *Lievsay*

222. English Non-Dramatic Poetry of the Sixteenth Century. *Lievsay*

223. Spenser. *Lievsay*

224. Shakespeare. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*

229. English Literature in the Seventeenth Century. *Lievsay, Randall, an Williams*

232. Milton. *Lievsay*

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. Middle High German. *Stern*

215S. Seventeenth-Century Literature. *Borchardt*

217S. Renaissance and Reformation Literature. *Borchardt*

DEPARTMENT OF HISTORY

103, 104. Renaissance and Reformation. *Witt*

107. Social and Cultural History of England. *Ferguson*

133, 134. Medieval History. *Young*

195A-196A. Renaissance Intellectual History. *Witt*

195L-196L. Europe in the Age of the Reformation, 1500-1650.

195N-196N. The English Renaissance. *Ferguson*

221-222. Problems in the History of Late Medieval Europe and Earl Modern Europe. *Witt*

225, 226. The Age of the Reformation.

237-238. Europe in the Middle Ages, 395-1500. *Young*

267-268. From Medieval to Early Modern England. *Ferguson*

DEPARTMENT OF MUSIC

156S. Music History I: History of Music from 1600 to 1750. *Saville*

159S. Music History IV: History of Music to 1600. *Kirkendale*

166S. The Renaissance Madrigal. *Saville*

DEPARTMENT OF PHILOSOPHY

117. Ancient and Modern Ethical Theories. *Welsh*

119. Introduction to Medieval Philosophy. *Mahoney*

218. Medieval Philosophy. *Mahoney*

DEPARTMENT OF ROMANCE LANGUAGES

French

104S. The Sixteenth Century. *Vincent and Tetel*

106S. Montaigne. *Tetel*

117S. Masterpieces of French Medieval Literature. *Ripley*
119. French Drama of the Seventeenth Century. *Auld*
213. French Literature of the Seventeenth Century. *Auld*
219. Old French Literature. *Vincent*
225. From Renaissance to Baroque in French Literature of the Sixteenth entury. *Tetel*

alian

101, 102. Masterworks of Italian Literature in English Translation. *Caserta*
183. Readings in Italian Literature. *Caserta*
284. Dante. *Fowlie*
288. The Renaissance. *Tetel*

panish

117S. Masterpieces of Spanish Medieval Literature. *Murray*
161. Spanish Literature of the Renaissance and the Baroque. *Miller*
167. Golden Age Literature: Cervantes. *Predmore*
170. The Picaresque Novel. *Murray*
251. The Origins of the Spanish Novel. *Wardropper*
252. Spanish Lyric Poetry Before 1700. *Wardropper*
253. The Origins of the Spanish Theatre. *Wardropper*
258. Old Spanish Literature. *Davis*
265. Golden Age Literature: Cervantes. *Predmore and Wardropper*
266. Golden Age Literature: The Drama. *Wardropper*

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rofessor J. Mueller, *Chairman;* Professor J. Hanks, *Director of Undergraduate udies;* Associate Professor P. Bryan, *Supervisor of Freshman Instruction;* Prossors Bone, Hamilton, and Withers; Associate Professors Kirkendale and Saville; esident Artist Ciompi; Lecturer Smith; Assistant Professors Bullock, Erickson, d Henry; Visiting Assistant Professor Maves; Part-time Instructor Witherspoon; aff Associates Evans, Featherstone, Gulick, Hurd, Phelps, Redding, and Ward

HEORY AND COMPOSITION

7-8. Dictation and Sight-Singing. Techniques of aural analysis and deelopment of sight-reading skills. Music majors should take this course conurrently with Music 65-66. Skill course. Half-course each semester. *Witherspoon*

65. Fundamentals of Music Theory. Physical properties of sound; prinples of diatonic tonal organization; melodic and harmonic constructions; elemenry counterpoint and figured base. Skill course. Prerequisite: basic knowledge of usical notation and vocabulary. Music majors should take Music 7 concurrently. ne course. *Maves and Gulick*

66. Tonal Harmony. Harmonic language of eighteenth and nineteenth ntury classicism; functional chromatism, sectional forms. Music majors should ke Music 8 concurrently. Prerequisites: Music 65 and 7. One course. *Gulick d Maves*

67S, 68S. Composition I. Composing original music in the smaller forms r voice, piano, and other instruments. Studies in contemporary compositional techniques. Prerequisite: Music 65, 66 or consent of instructor. Two course *Hamilton and Maves*

107-108. Keyboard Theory. Harmonic principles of tonal music applie to the keyboard; score reading, figured bass, melodic harmonization, modulatio transposition. Music majors should take this concurrently with Music 115-11 Skill course. Prerequisites: Music 65-66, 7-8, and keyboard proficiency. Hal course each semester. *Witherspoon*

115S. Modal Counterpoint. Polyphonic, contrapuntal, and melodic pra tices found in the sacred and secular works of the sixteenth and seventeenth ce turies. Music majors should take Music 107 concurrently. Prerequisite: Mus 65-66. One course. *Maves*

116S. Linear Tonal Practice. Organic tonal elements (including cano invention, chorale prelude, fugue) as found in the works of Bach, Mozart, Hayd Beethoven, and Brahms. Prerequisite: Music 76, 77. One course. *Maves*

117S, 118S. Music Theory III: Composition and Analysis. The develo ment of technical and expressive means in various media and styles. The compl tion of an original work in an instrumental or choral medium. Prerequisite: Mus 116, 139, 158, or consent of instructor. Two courses. *Hamilton*

122. Orchestration. The technical characteristics and transpositions of th instruments of the modern symphony orchestra and concert band. Instrumentatio of piano scores of original compositions for string, woodwind, and brass ensen bles. Prerequisite: Music 116. One course. *Bryan*

HISTORY AND LITERATURE

51-52. Introduction to Music Literature. The literature of music of Wes ern civilization; acquisition of critical insights into musical styles, forms, and tec niques. Representative works of major composers in all media, instrumental an vocal. Two courses. *Staff*

125. Masterworks of Music Literature. An intensive study of selecte masterworks which represent the principal currents in modern music history. Con positions by Bach, Mozart, Beethoven, Brahms, Debussy, and Bartok will constitu a frame of reference for historical, biographical, and stylistic analysis. One cours *Bone, Erickson, and Mueller*

139. Twentieth-Century Music. Influential creative stylistic developmen in music of the present century. A critical survey of works by Bartok, Berg, Schö berg, Stravinsky, and Webern as a means of establishing a relative standard values for subsequent independent exploration. Prerequisite: a one-year course i music theory or literature, or consent of the instructor. One course. *Bullock*

156S. Music History I: History of Music from 1600 to 1750. Prerequ sites: Music 7-8, 65, or consent of instructor. One course. *Saville*

157S. Music History II: History of Music from 1750 to 1830. Prerequ sites: Music 7-8, 65, or consent of instructor. One course. *Bryan*

158S. Music History III: History of Music from 1830-1910. Prerequ sites: Music 7-8, 65 or consent of instructor. One course. *Hamilton and Erickso*

159S. Music History IV: History of Music to 1600. Prerequisite: Music 7-

55 and two courses in music history, or consent of the instructor. One course. *Kirkendale*

163. Music in the Eighteenth Century. The development of important in- trumental and vocal media and formal concepts through study of the music, the nusicians, and their environment. One course. *Bryan*

164. Music in the Nineteenth Century. The interaction of musical, artistic, ınd literary movements in the cultural life of the century. One course. *Mueller*

165. Opera Literature. From the Florentine Camerata to the present. The perati c idea, with attention to changing relationships of music and text; opera as ocial commentary; formal and stylistic means. Selected composers from Mont- verdi to Berg. One course. *Saville*

166S. The Renaissance Madrigal. History of Italian and English madri- al forms from the fourteenth century Ars Nova through the Renaissance into the arly Baroque of the 1620's. Ability to read music and some experience with Ital- an helpful but not required. One course. *Saville*

NDEPENDENT STUDY AND SEMINARS

Admission to these courses will be subject to the approval of the Director of Jndergraduate Studies of the Department of Music and the individual instructor. The instructor as well as the course content will be established in accordance with he individual student's interests and capacities.

The department offers work leading to Graduation with Distinction. See the ection on Academic Honors.

179, 180. Independent Study in Musical Performance.* Open only to ophomores possessing an exceptional technical and interpretive command of a nusical medium. Prerequisites: previous registration in private instruction in pplied music at Duke, audition, and permission of instructor. Two courses. *Staff*

181, 182. Independent Study in Musical Performance.* Same as 179, 80, but for juniors. Two courses. *Staff*

183, 184. Independent Study in Musical Performance.* Same as 179, 80, but for seniors. Two courses. *Staff*

185S, 186S. Seminar in Music. Guidance in the sources and materials of nusic and in the methods of stylistic analysis and criticism. A background of his- orical, stylistic, and theoretical knowledge is essential. Formal papers required. Two courses. *Staff*

191, 192. Independent Study. Directed reading, research, and musical nalysis within a prescribed area of musical literature. Open only to highly quali- ied students in the junior year, by permission of the department. One or two ourses. *Staff*

193, 194. Independent Study. Same as 191, 192, but for seniors. One or wo courses. *Staff*

195S, 196S. Seminar in Music. Same as 185S, 186S but for seniors, not ecessarily restricted to candidates for degree with distinction. Two courses. *Staff*

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*The schedule of fees for private lessons as published on page 177 is applicable to ourses 179, 180, 181, 182, 183, 184.

MUSIC EDUCATION AND PEDAGOGY

57S, 58S, 59S, 60S. Vocal Diction. Problems of diction for the singer Study of standard pronunciation with special emphasis on phonetics in English Italian, German, and French. Four half-courses. *Hanks*

121. Conducting. The conducting of orchestral and vocal scores. Score-reading and analysis, principles of interpretation, establishment of vocal and instrumental conductoral techniques leading to practical experience in conducting the department musical organizations in rehearsal. Prerequisite: Music 76, 77, 116, or consent of instructor. One course. *Bone*

151. Public School Music Education (Elementary). Development of the child through music. Child voice and song literature; rhythmic activities; learning to listen; use of elementary instruments such as the autoharp, psaltery, bells, rhythm band instruments. Both group and individual help in elementary music theory music reading exercises; chording and improvising piano accompaniments; conducting; construction of rhythm band scores. Integration of music with other activities such as planning music for social studies units. Half-course. *Witherspoon*

152. Public School Music Literature (Elementary). A study and analysis of key works in the symphonic, pianistic, and vocal repertoire which are particularly applicable to the teaching of music appreciation as a cultural aspect of social studies in the public school. Half-course. *Witherspoon*

153. Vocal Music in the Public School (Secondary). Repertoire and methods for teaching vocal music in the junior and senior high schools. Aims, organization, administration, training, and performance of school choirs and ensembles care of the changing voice. One course. *Saville*

154. Instrumental Music in the Public School (Secondary). Material and methods of teaching instrumental music in the junior and senior high schools emphasis on teaching techniques, repertoire, organization, and administration of the instrumental curriculum. One course. *Bone*

APPLIED MUSIC

The study of applied music concerns the understanding of music literature through performance. Private instruction is offered in instruments and voice. Class instruction is offered in small and large ensemble experience. Students must arrange an audition with the instructor prior to registration, either in person or by tape recording. All courses may be repeated for credit. Not more than two quarter credit courses in the ensemble group (courses 100 and above) may be taken concurrently.

Private instruction: ½ hour, ¼ course credit

80. Piano. *Whithers, Phelps, Bullock, and Erickson*
81. Strings. *Ciompi and Mueller*
82. Woodwinds. *Henry*
83. Brass. *Bryan*
84. Percussion. *Maves*
85. Voice. *Hanks and Redding*
86. Organ. *Gulick and Hurd*

rivate instruction: 1 hour, ½ course credit

90. Piano. *Withers, Phelps, Bullock, and Erickson*
91. Strings. *Ciompi and Mueller*
92. Woodwinds. *Henry*
93. Brass. *Bryan*
94. Percussion. *Maves*
95. Voice. *Hanks and Redding*
96. Organ. *Gulick and Hurd*

nsemble classes: ¼ course credit

100. Symphony Orchestra. *Bone*
101. Wind Symphony. *Bryan*
102. Marching Band. *Henry*
103. Jazz Ensemble. *Holton*
104. String Ensemble. *Staff*
105. Wind Ensemble. *Staff*
106. Piano Ensemble. *Staff*
109. Chancel Singers. *Saville*
110. Madrigal Singers. *Saville*
111. Opera Workshop. *Hanks*
112. Chapel Choir. *Smith*
113. Chorale. *Smith*

Credit in Applied Music. (Skill courses—credit not applicable to distribu-ional requirements.*) Credit for instruction in courses below 100 is granted on he basis of a half-course per semester for one hour of private instruction per week nd a minimum of six hours practice weekly; or a half-course per year for one-half our of private instruction, or one period of class study, and a minimum of six ours practice per week. An additional weekly class meeting for performance and riticism may be required by the instructor without additional credit. Credit for nstruction in courses above 100 is granted on the basis of a half-course per year or one rehearsal period of instruction and a minimum of three hours practice per veek.

Fees. Students who have been accepted as music majors at the time of egistration for applied music courses are exempt from paying the applied music ees. Other students are charged for all applied music media below 100.

Fees are payable to the Bursar's Office of Duke University upon notification rom that office at the beginning of each semester as follows:

One ½ hour private lesson per week for one semester	$ 60.00
Two ½ hour private lessons per week or one 1-hour private lesson per week for one semester	100.00
One 1-hour class lesson per week for one semester	25.00

All students registered for applied music instruction are charged for practice oom facilities—students having practice facilities off campus *must* notify the de-artmental office of this fact by the end of the third week of *each* semester; other-vise they will be automatically billed as follows:

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*Subject to instructors approval, a student at an advanced level in applied music nay take courses for tutorial and distributional requirements. These courses shall be lesignated by adding a *T* to the appropriate course number. Beginning students and thers who have not reached an advanced level will continue to take the regular applied nusic courses.

Room with piano or organ: $20.00 per semester
Room without piano: $15.00 per semester

DEPARTMENTAL MAJOR

Prerequisites. Music 7-8, 107-108, 65, 66, and one year of applied musi study in instrument or voice. Any or all of these may be exempted through demonstration of proficiency by examination and/or audition.

Major Requirements. Music 115, 116, 156, 157, 158. 159, and one additional elective course in the department.

Naval Science

For courses in Naval Science, *see* Reserve Officers Training Program.

Philosophy

Professor Welsh, *Chairman;* Assistant Professor Aquila, *Director of Undergraduat Studies;* Professors Negley and Peach; Associate Professors Mahoney, Roberts and Sanford; Visiting Associate Professor Evans; Assistant Professors Benditt Coder, and Ross

The undergraduate program in the Department of Philosophy is designed t acquaint students with the content and the structure of philosophical theory i various areas. Discussion is encouraged so that the student can engage actively i the philosophical examination of problems.

Course offerings fall into two general categories: the systematic and the historical. In a systematic treatment, the organization of a course is primarily in term of the problems presented by the subject matter of that course, as in logic, ethics and metaphysics. In historical courses, attention is directed more to the order o development in the thought of a particular philosopher (Plato, Aristotle, Kant) or in a historical period. In all courses, reading of the works of philosophers wil acquaint the students with the important and influential contributions to the definition and solution of philosophical issues.

The problems raised in philosophy in respect to the various fields of th arts and sciences involve questions which are not normally given attention in thos particular disciplines. In the consideration of such problems, therefore, it is expected that the student will acquire some understanding and perspective of the majo areas of man's intellectual endeavor. In this sense, philosophical comprehensio is an essential part of a student's learning and education.

Only one of 41, 42, 43S, or 44S may be taken for credit. Not open to junior and seniors.

41. Introduction to Philosophy. Examination of problems in philosophy emphasis on metaphysics and theory of knowledge. One course. *Staff*

42. Introduction to Philosophy. Examination of problems in philosophy emphasis on ethics and value theory. One course. *Staff*

43S. Introduction to Philosophy. Philosophy 41 conducted as a semina One course. *Staff*

44S. Introduction to Philosophy. Philosophy 42 conducted as a semina One course. *Staff*

48. Logic. A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Coder, Ross, and Sanford*

93. History of Ancient Philosophy. The Pre-Socratics, Socrates, Plato, Aristotle, and post-Aristotelian systems. Freshman prerequisite: previous philosophy course and permission of instructor. One course. *Evans, Mahoney, and anford*

94. History of Modern Philosophy. Bacon, Hobbes, Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant. Freshman prerequisite: previous phiosophy course and permission of instructor. One course. *Aquila, Peach, and Roberts*

101. Philosophy of Religion. Selected concepts and doctrines. One course. *Roberts*

102. Aesthetics: The Philosophy of Art. The concept of beauty, the work f art, the function of art, art and society, the analysis of a work of art, criticism in he arts. One course. *Welsh*

103. Symbolic Logic. Detailed analysis of deduction and of deductive sysems. Open to sophomores by permission of instructor. One course. *Coder*

104. Philosophy of Science. The principal philosophical and methodologial problems in contemporary science. One course. *Ross*

106. Philosophy of Law. Natural law theory; legal positivism; legal realism; he relation of law and morality. One course. *Benditt*

107. Political and Social Philosophy. Discussion of the fundamental principles of political and social organizations, with particular attention to democratic hilosophy, corporate theory, and Marxist-Soviet philosophy. One course. *Negley*

108. Social Ideals and Utopias. Reading of selected Utopias; analysis of he value-structures and political principles of these ideal societies. One course. *Negley*

109. Philosophy of Language. A philosophical analysis of problems arising in the study of language and symbolism. Topics include: theories of language, he nature of signs and symbols, theories of meaning, types of discourse (scientific, mathematical, poetic), definition, ambiguity, metaphor. One course. *Welsh*

110. Epistemology. A treatment of the problems of truth and knowledge; f *a priori* and emprical statements; and of theories of perception and probability. One course. *Sanford and Coder*

111. Metaphysics. A selection from the following: theories of substance, niversals, identity, space, time, and causality; determinism and action; the relation f mind and body. Prerequisite: one course in philosophy. One course. *Sanford*

112. Philosophy of Mind. Such topics as mind and body, thought, percepon, persons, and personal identity. One course. *Aquila*

116. Systematic Ethics. Problems in moral philosophy: the nature of morality, ethical relativism, egoism, utilitarianism. Both historical and contemporary eadings, with emphasis on the latter. One course. *Benditt*

117. Ancient and Modern Ethical Theories. The development of ethic thought in the West; the interaction between culture and ethical theory, with sp cial reference to the Greek city-state, Roman law, the Renaissance, the Reform tion, and the rise of modern science. Readings in the great ethical philosophe One course. *Welsh*

119. Medieval Philosophy. Readings and discussion of Christian, Islami and Jewish philosophy from late antiquity to 1300. Special emphasis on t nature and destiny of man, human knowledge and conduct, and the question of t existence and nature of God. One course. *Mahoney*

120. Late Medieval and Renaissance Philosophy. Critical trends fourteenth century philosophy; Renaissance Platonism, humanism and theories love; Aristotelianism and the immortality controversy; the rebirth of scepticis and the rise of modern philosophy. One course. *Mahoney*

132. Nineteenth-Century Philosophy. Major nineteenth-century philo ophers; emphasis on the German tradition: Hegel, Schopenhauer, and Nietzsch One course. *Aquila*

134. Existentialism. One or more major texts, such as Sartre's *Being a Nothingness.* One course. *Aquila*

191, 192, 193, 194. Independent Study. Directed reading and researc Open only to highly qualified students in the junior and senior years, by permi sion of the department. *Staff*

196S, 197S, 198S, 199S. Seminars in Philosophy. Prerequisite: o course in philosophy or consent of instructor. One course each. *Staff*

For Seniors and Graduates

202. Aesthetics: The Philosophy of Art. A study of some fundament issues in aesthetics with particular reference to the fields of literature, music, an painting. Problems discussed include the role of standards in criticism, aesthet judgment, interpretation, and evaluation in the arts, meaning in the arts, art an truth, the arts and morality. Open to juniors with the approval of the instructo One course. *Welsh*

203. Contemporary Ethical Theories. Study of the nature and justificatio of basic ethical concepts in the light of the chief ethical theories of twentieth-ce tury British and American philosophers. One course. *Benditt*

204. Philosophy of Law. Natural law theory and positivism; the idea obligation (legal, political, social, moral); and the relation of law and moralit One course. *Benditt*

205. The Philosophy of History. Discussion of the method, metaphysic implications, and influence of interpretations of history; Hegel, Marx, Spengle Toynbee. One course. *Negley*

208. Political Values. Analysis of the systematic justification of politic principles and the political values in the administration of law. One course. *Negle*

211. Plato. A critical study of selected dialogues, with emphasis on prob lems in epistemology and metaphysics. One course. *Mahoney*

217. Aristotle. A study of passages from the *Organon, Physics, De Anima,* d *Metaphysics.* One course. *Evans and Mahoney*

218. Medieval Philosophy. Selected problems in medieval philosophy. e course. *Mahoney*

219. Kant's Moral Philosophy.* One course. *Negley*

225. British Empiricism. A critical study of the writings of Locke, Berke- , or Hume with special emphasis on problems in the theory of knowledge. One urse. *Peach*

227. Continental Rationalism. A critical study of the writings of Descar- , Spinoza, or Leibniz with special emphasis on problems in the theory of knowl- ge and metaphysics. (1972-3: Leibniz.) One course. *Peach and Roberts*

228. Recent and Contemporary Philosophy. A critical study of some con- nporary movements in philosophy with special emphasis on the work of Moore, ssell, Wittgenstein, Wisdom, and Ryle. One course. *Welsh*

229. American Pragmatism. Studies in the philosophy of Peirce, James, wey, and Mead. One course. *Welsh*

231. Classical German Philosophy. Selected topics in eighteenth and nine- nth century German philosophy. One course. *Aquila*

232. Recent Continental Philosophy. Selected topics. One course. *Aquila*

233. Methodology of the Empirical Sciences. Recent philosophical dis- ssion of the concept of a scientific explanation, the nature of laws, theory and ob- vation, and other topics. Approval of instructor required for undergraduates and dents from departments other than philosophy. One course. *Ross*

234. Problems in the Philosophy of Science. Selected problems in the ysical and non-physical sciences: space and time, measurement, probability and luction, and the philosophy of the behavioral and social sciences. Approval of tructor required for undergraduates and for graduate students in departments er than philosophy. One course. *Roberts and Ross*

241. Symbolic Logic. Detailed analysis of deduction and of deductive sys- ns. One course. *Coder*

251. Epistemology. Selected topics in the theory of knowledge, e.g., con- ions of knowledge, scepticism, and certainty, perception, memory, knowledge of er minds, and knowledge of necessary truths. One course. *Coder and Sanford*

252. Metaphysics. Selected topics: substance, qualities and universals, ntity, space, time, causation, and determinism. One course. *Sanford*

253. Philosophy of Mind. Analysis of concepts such as thought and belief; ues such as mind-body relations, thought and action, the nature of persons d personal identity. One course. *Aquila and Coder*

260. Wittgenstein. An examination of the *Tractatus* or the *Investigations.* e course. *Welsh*

291, 292. Seminars in Special Topics. One course each. *Staff*

* Offered on demand.

DEPARTMENTAL MAJOR

Major Requirements. Eight semester courses in philosophy of which at le t six must be in courses numbered above 48. The following must be includ: Philosophy 93 and 94; one non-introductory course in theory of value. Philosop 48 (Logic) is recommended, though not required, for those intending to ma r in philosophy.

Related Work. Two courses minimum in each of two departments approv by the philosophy adviser. Courses may not be those primarily open to freshm. There is no restriction in principle as to departments in which related work may e taken, and the approval of the philosophy adviser is required only to ensure so e coherence in the program of major and related work as a whole.

The department offers work leading to graduation with distinction. See e section on Honors.

Physics

Professor Fairbank, *Chairman;* Assistant Professor Rose, *Director of Und-graduate Studies;* Professor David W. Carpenter, *Supervisor of Freshman Instr-tion;* Professors Biedenharn, Bilpuch, Gordy, Greuling, Lewis, Meyer, News, Robinson, Robl, and Walker; Associate Professors Cusson, Evans, Fortney, H, Roberson, and Walter; Assistant Professors De Lucia, Loos, Riedel, and Syk; Instructors Clement and Moses

1, 2. Introductory Physics. This course traces historically and experim-tally the development of the important principles of physics. Open to freshm, sophomores, and juniors. Three lectures and one two-hour laboratory. Two cours. *Clement*

41, 42. Fundamentals of Physics. For students interested in majoring n physics; taken in the freshman year. Basic principles of physics, mainly classic, at a level similar to Physics 51-52, but with emphasis on laying a foundation r further study. Three lecture-recitations and one three-hour laboratory. Prerequisit: approval of the department and Mathematics 31-32 or equivalent (may be tak n concurrently). Two courses. *Rose*

41P, 42P. Preceptorials. Elective preceptorials for students enrolled n Physics 41, 42.

51, 52. General Physics. Basic principles of general physics treated m e quantitatively than Physics 1, 2. Designed for students entering medicine, engine-ing, and the sciences. Not open for credit to students who have completed Phys s 1, 2 or 41, 42. Students planning to major in physics should enroll in Physics , 42 in their freshman year. Prerequisites: Mathematics 31, 32 or equivalent (m y be taken concurrently with permission of instructor). Two courses. *De Luc, Evans, Fairbank, Fortney, Greuling, Han, Helminger, Lewis, Moses, Robers, Robinson, and Walter*

51P, 52P. Preceptorials. Elective preceptorials for students enrolled n Physics 51, 52.

55. Introduction to Astronomy. Man's evolving theory of the physi l universe. Cosmological models, galaxies, stars, interstellar matter, the solar syste, and experimental techniques and results. Optional observational laboratory. Ce course. *De Lucia*

161, 162. Modern Physics. Relativity, quantum phenomena, atomic and olecular structure and spectra, solids, statistical physics, nuclear physics, elemen- ary particles. Prerequisites: Physics 41-42 or 51-52 and Mathematics 32; Physics 61 is prerequisite for 162. Two courses. *Evans and Han*

171. Electronics. A. C. circuits, transients, fundamentals of vacuum tubes nd electron physics, basic electronic circuits. Three lectures and one three- our laboratory. Prerequisites: Physics 41-42 or 51-52. One course. *Fortney*

176. Thermodynamics and Kinetic Theory. Thermodynamics, kinetic eory, and elementary statistical mechanics. Prerequisites: Physics 41-42 or 51- 2. and differential and integral calculus. One course. *Meyer*

181, 182. Classical Mechanics. Newtonian mechanics at the intermediate vel. Motion of systems of particles and rigid bodies; conservation theorems; small scillations; force problems and classical scattering. Prerequisites: Physics 41-42 or 1-52, and differential and integral calculus. Two courses. *Walker*

185. Optics and Spectroscopy. Wave motion; Fourier methods; geometri- l and physical optics; coherence; lasers; atomic and molecular spectra. Prereq- isites: Physics 41-42 or 51-52, and differential and integral calculus. One course.

187S, 188S. Topics in Modern Physics. A group tutorial on selected topics ch as particle physics, general relativity, liquid helium, and superconductivity. rerequisites: Physics 161, and differential and integral calculus. Two courses. *usson and Staff*

A course in general college physics and a course in differential and integral lculus are prerequisites to all courses numbered 200 and above.

209. Introduction to Solid State Physics. Basic physical processes in solids ith emphasis on dielectrics, metals, and semiconductors; crystal structure, thermal d magnetic properties. One course.

215. Introduction to Quantum Mechanics. Wave-mechanics and elemen- ry applications; the hydrogen-like atoms; electron spin and angular momentum; erators and eigenvalues; stationary state perturbation theory; identical particles. rerequisites: Physics 162, 182 or equivalents; Mathematics 285-286 should be ken concurrently. One course. *Staff*

217S, 218S. Advanced Physics Laboratory and Seminar. Experiments in- lving the fields of mechanics, electricity, magnetism, heat, optics, and modern ysics. Two courses. *Meyer*

220. Advanced Electronics. Vacuum tubes and solid state devices, ad- nced circuit analysis. Three lectures and one three-hour laboratory. One course. *rtney*

221, 222. Theoretical Physics. Mechanics of particles and of rigid bodies, asticity, fluids dynamics, electrodynamics; optics, relativity, thermodynamics, atistical mechanics, wave mechanics. Prerequisite: Mathematics 285-286 or equiv- ent to be taken at least concurrently. Two courses.

223, 224. Electricity and Magnetism. Electrostatics, magnetostatics, and tential theory; dielectric and magnetic media; magnetic field of currents and law induction; Maxwell's electrodynamics, theory of wave optics, refraction, inter- rence and diffraction. Two courses. *Loos*

225, 226. Elementary Investigations. The aim of this course is to provic training in the laboratory and library methods of physical research. Properly qua ified students may conduct elementary investigations under the supervision of member of the staff. One course each semester. *Staff*

DEPARTMENTAL MAJOR

A student planning to major in physics should enroll in Physics 41-42 in his fresl man year. He should also arrange to complete the necessary mathematics as soo as possible. A special section (denoted by an *X* in the course schedule) has bee arranged in Physics 161-162. This section is primarily for physics majors, and it recommended that persons planning to major in physics should attempt to fit it int their schedules. Since Physics 1-2 is intended primarily for non-science majors, is not recommended for physics majors.

The A.B. degree

Prerequisites. Physics 41-42 or 51D-52D or equivalent; Mathematics 31-3 or equivalent, 73, 74, or 131; Chemistry 11, 12.

Major Requirements. At least eight semester-courses in physics from th available 100- and 200-level courses. Of these at least two courses must be labc ratory courses. A physics major also normally takes two courses of related wor beyond the introductory level, approved as a program by his physics adviser.

The B.S. degree

Prerequisites. Physics 41-42 or 51D-52D or equivalent; Mathematics 31-3 or equivalent, 73, 74, or 131; Chemistry 11, 12.

Major Requirements. At least ten semester-courses in physics from the avai able 100- and 200-level courses. At least two of these must be laboratory course A B.S. physics major also normally takes three courses of related work beyon the introductory level, approved as a program by his physics adviser.

The department offers to the student in his senior year the possibility of beir associated with research conducted in this institution. Such work may lead t graduation with distinction. See the section on Honors.

Political Science

Professor Barber, *Chairman;* Assistant Professor Spragens, *Director of Unde graduate Studies;* Professors Ball, Braibanti, Cleaveland, Cole, Cook, Grzybowsk Hall, Hallowell, Kornberg, Kulski, Leach, and Simpson; Visiting Professor Fried rich; Associate Professors Fish and Johns; Assistant Professors Eldridge, Hawley Paletz, Trilling, and Valenzuela; Instructors Mook and Payne; Lecturers Mishle and O'Barr

The objective of the Department of Political Science is to acquaint student with the theory and practice of government and politics at the local, state, nationa and international levels. Although primary attention is focused upon the Ameri can political and administrative system, emphasis is also placed upon a comparativ study of the political institutions and movements of thought peculiar to the nations c Europe, Latin America, Africa, and Southern Asia. The student's attention is als directed to the problems encountered in international organization, politics, an law. The development of political philosophy from Plato to the present day is a ssential part of the department's course offerings. Methods of study include the mpirical, the historical, the legal, the comparative, and the philosophical.

Directing its effort to an intelligent understanding of the contemporary world nd of the responsibilities which are laid upon citizens of a democracy, the Depart- nent of Political Science shares the objectives of a liberal arts education. Although he department does not aim at vocational education, the knowledge it seeks to im- art should be useful to anyone contemplating a career in law, government service, r politics.

Students intending to major in the department should take Political Science 1 or 61D. Ordinarily one of them must be taken before proceeding to more ad- anced work in the department. This rule may be waived with the consent of the irector of Undergraduate Studies.

The advanced courses are divided into four major groups. Majors are re- uired to take at least one course in three of these groups.

Political Science 197 and 198 are designed to provide an opportunity for ajors in the department to qualify for graduation with distinction.

NTRODUCTORY COURSES

61. The American Political System. Theory and practice of American overnment and politics. Federal-state relations, the separation and interrelation- hips of the executive, legislative, and judicial branches of government, judicial eview, the role of political parties and public opinion, the formulation and execu- ion of domestic and foreign policy, civil liberties. One course. *Staff*

61D. The American Political System. A discussion section format of olitical Science 61. One course. *Staff*

Students planning to major in political science or students seeking to meet the ocial science requirement should follow Political Science 61 or 61D with a 100- evel course of their choice. Sophomores may not register in courses numbered bove 200.

OLITICAL THEORY AND METHODOLOGY

106. Ethnic Politics. One course. *Payne*

123. Introduction to Political Philosophy. The nature and enduring prob- ems of political philosophy, illustrated by selected theorists in the Western politi- al tradition. One course. *Spragens*

126. Democratic Theory and Political Reality. Normative goals and em- irical analyses of existing democratic states. One course. *Spragens*

131. Introduction to American Political Thought. Basic elements in the merican political tradition as developed from its English roots to the present. One ourse. *Cook*

132. Contemporary Political Ideologies. Communism, fascism, democracy, nd other significant ideologies. One course. *Cook*

133. Policy Choice as Value Conflict. The normative dimensions of public olicy. Analysis of cases in selected policy areas, including the space program, overty, ecology, and higher education. Prerequisite: consent of the instructor. Also listed as Public Policy Studies 116.) One course. *Payne*

197S. Principles and Methods of Political Inquiry. Philosophical, scientific, and behavioralistic approaches to political problems; contemporary conceptua frameworks, including systems analysis and functionalism, group theory, and mathematical models. Prerequisite: consent of the instructor. One course. *Trilling*

222. Empirical Theory. Critical examination of contemporary, non-normative conceptual frameworks for political inquiry, with emphasis on the qualifications of these frameworks as theories. One course. *Trilling*

223. Political Philosophy from Plato to Machiavelli. Intensive analysis o the political philosophies of Plato and Aristotle, a survey of medieval politica thought and an analysis of the significance of Machiavelli. One course. *Hallowel*

224. Modern Political Theory. An historical survey and philosophica analysis of political theory from the beginning of the seventeenth to the middle o the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism One course. *Hallowell*

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism an its variants, socialism in the Soviet Union, nationalism, Fascism and National Socialism, the crisis in modern democracy, Christianity, and the social order. One course *Hallowell*

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day, with emphasi upon the development of liberalism in America. One course. *Cook*

233. Research Methodology. Elements in research design; interdependence of theory and research. One course. *Trilling*

236. Statistical Analysis. An introduction to the descriptive and analytical uses of statistics in political research. Prerequisite: graduate standing or permission of instructor. One course. *Trilling*

243. Administrative and Organizational Theory and Behavior. On course. *Hawley*

249. Comparative Political Analysis and Political Development. Genera methodology of comparison of political systems. Institutional, structural, functional and configurative modes of analysis. Theory of political development. Theoretica problems of induced political change. One course. *Braibanti*

260. The Tradition of Political Inquiry. Past and present problems, goals. presuppositions, and methods. One course. *Spragens*

COMPARATIVE GOVERNMENT AND POLITICS

101, 102. Introduction to the Civilizations of Southern Asia. (Also liste as Interdisciplinary Course 101, 102.)

117. Comparative Legal Systems. Origins, development, and mutual influences of modern legal systems: Roman and civil law; the Common Law and th Anglo-Saxon tradition; Islamic law; Communist legal systems and the legal system of Black Africa. One course. *Grzybowski*

135. Comparative Legislative Behavior. Structures, processes, functions, nd behavior of legislatures and legislative-like institutions in a variety of Western nd non-Western societies with emphasis on the role of legislatures in policy formaion, national integration, and modernization/development. One course. *Mishler*

136. Comparative Government and Politics: Europe. The impact of social nd economic change of European politics. Totalitarian vs. pluralistic models. ormal and informal political integration. Special attention to Great Britain, France, est and East Germany, the Soviet Union. One course. *Cole and Johns*

151. Comparative Government and Politics: Latin American I. Historical nd cultural context of political institutions and behavior; the role of traditional nd emerging groups and forces; political instability and the decision-making proess. One course. *Valenzuela*

152S. Comparative Government and Politics: Latin America II. Analysis f the politics of major countries including Argentina, Brazil, Chile, Cuba, and exico. One course. *Valenzuela*

155. Problems of Political Development in the New States. Survey of hange and modernization in Africa and Asia; nationalism and neutralism, role f political parties, the military, and the bureaucracy in nation-building; economic rowth and foreign aid. One course. *Braibanti*

161S. Comparative Government and Politics: Africa. Nationalism, nationuilding, and problems of development in selected states of sub-Saharan Africa. ne course. *Johns*

165S. The Government and Politics of the U.S.S.R. An analysis of the overnmental institutions, party structure, and policies of the Soviet Union. Attenon will be given to policies affecting the intelligentsia, workers, and peasants. One ourse. *Kulski*

166S. Soviet Foreign Relations. An analysis of relations between the Soviet nion and other states (Communist and non-Communist, Western, and undereveloped) as well as of the relations between the Communist Party of the Soviet nion with Communist parties in other countries. One course. *Kulski*

180. Comparative Government and Politics: Southern Asia I. Concepts f political development in new states, using India, Pakistan, Ceylon, and Malaysia s case studies. Theory and practice of foreign aid and technical assistance as gents of political modernization. One course. *Braibanti*

181. Comparative Government and Politics: Southern Asia II. The politial modernization of India and Pakistan since 1947. Constitutional developments as evealed in leading court judgments will be studied. Other topics will be the idelogy of administrative reform, formulation of state polity, rural development, and arty politics. One course. *Braibanti*

182S. Comparative Government and Politics: Japan. Political change in odern Japan. State-building, democracy, political values, participation, and elite ower. One course. *Mook*

214. Comparative Administrative Law. Comparative analysis of the role f administrative techniques in established and transitional constitutional systems. rench, German, British, and American patterns. Control of legality and expedincy of various types of judicial review. One course. *Grzybowski*

225. Comparative Government and Politics: Western Europe. Modern political institutions and processes in Western Europe. One course. *Cole*

235. The Commonwealth. Analysis of political relationships among the members of the Commonwealth and a comparative study of the political systems of the Commonwealth countries, with emphasis on Canada. One course. *Cole*

250. Comparative Government and Politics: Southern Asia. The politica development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional, and institutional aspects of the political systems. Impact of foreign technical assistance One course. *Braibanti*

253. Comparative Government and Politics: Latin America. Curren literature applicable to an understanding of the major themes of Latin American politics. One course. *Valenzuela*

271. Political Processes in Traditional and Modern Africa. Patterns of change in selected African societies from the pre-colonial to the post-colonia period, emphasizing the interaction between traditional, colonial, and post-colonia institutions and their impact upon African societies. (Also listed as History 219. One course. *Hartwig and Johns*

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. Emphasis upon research techniques and objectives. One course. *Kornberg*

280. Comparative Government and Politics: Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. One course. *Johns*

AMERICAN GOVERNMENT AND PUBLIC ADMINISTRATION

100. The Politics of Civil Rights and Liberties in America. Development and purposes, emphasizing the diverse institutional and other forces that enlarge or constrict them. One course. *Fish*

105. The Black American in Politics. Behavior of black people in the American political system, with special attention to voting organizations and the black power movement. One course. *Payne*

108S. The American Presidency. The presidency and its impact on the American political system. One course. *Paletz*

109. State and Local Government Today. Problems in state, county, and city government: administration of services such as education, public welfare, law enforcement, inter-governmental relationships, administrative reorganization, methods of popular control, and the reconstruction of state and local government to meet present-day needs. One course. *Leach*

111S, 112S-113S. Administration of Justice. Three sequential courses spring, summer (including internship), and fall, respectively. Prerequisite: permission of the instructors. (Also listed as Public Policy Studies, 151S, 152S-153S. *Pye and Staff*

114S, 115S-116S. Communications Policy. Three sequential courses, spring, summer (including internship), and fall, respectively. Prerequisite: permission of the instructors. (Also listed as Public Policy Studies, 154S, 155S-156S.) *Lange, Paletz, and Patterson*

125. American Political Parties and Practical Politics. A study of the historical development, organization, and methods of political parties in the United States. One course. *Simpson*

127. Law and Society. Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators, and administrators in the development of public as well as private law. One course. *Fish*

129. Groups in American Politics. Theory and practice of the interest group approach to the study of American politics. One course. *Paletz*

130. Politics and the Media of Mass Communication. Activities of the media of mass communication as they affect the American political system and process. Governmental impact on the mass media. One course. *Paletz*

134S. Problems in Communication. The structure and functioning of American communications media, origins of current conflicts, and theory of alternative policies. Prerequisite: consent of the instructor. (Also listed as Public Policy Studies 108S.) One course.

137. Political Behavior in Elections. Political participation; public opinion; voting behavior, sociological and psychological bases, comparative studies, models and methodology of research. One course. *Trilling*

138. Political Behavior in Policymaking. A study of the major factors that come into play in the making of governmental policy decisions. Special attention will be paid to the role of pressure groups and the methods of their lobbyist representatives, to the effects of pressures from constituents, and to the pressures of the executive and legislative branches upon each other. One course.

139. Science and Government. The impact of science on governmental policies. processes, and institutions. The effect of government on science. One course.

141S. Public Administration. An introduction to the role of administration n the governmental process considering principles of administrative organization, methods of administrative control, personnel, and fiscal management. In general the study of the organizational and administrative problems encountered by any government agency charged with carrying out a public policy. One course. *Hall*

142. Administrative Responsibility. An evaluation of political, legal, and administrative methods of achieving a responsible bureaucracy in American national government. Comparisons with relevant experience and techniques in other countries such as Great Britain and France. One course. *Hall*

143. The Politics of Distribution. Governmental policies in areas such as education, housing, health, and welfare to which significant allocations of resources have recently been made. One course.

145. Political Analysis for Public Policymaking. Analysis of the political and organizational processes which influence the formulation and implementation of public policy. Alternative explanatory models. One course. *Hawley*

146. Legislation. A study of the composition and structures of legislativ bodies and of the legislative process with attention to procedure, methods, techniques, delegation of discretion, and the use of controls. One course. *Simpson*

164. Government Regulatory Policy and Administration. Regulatory policies of the U.S. government; administrative procedures and organizations designe to implement those policies. One course.

167S. Ecology and Social Action. (Also listed as Interdisciplinary Cours 167S.)

170S. The Legal Process and Social Change. The role of the legal system in effecting and mediating social change. Consideration of different strategie and the circumstances in which they are effective. One course. *Fleishman*

174. Political Implications of Economic Legislation. A study of politic and sectional alignments in the passage of tariff, farm, railway, New Deal, an other economic legislation. One course. *Simpson*

199. The Changing South. (Also listed as Interdisciplinary Course 199.)

207. American Constitutional Interpretation. Development of the Constitution of the United States through Supreme Court decisions. Prerequisite Political Science 127. One course. *Fish*

209. Problems in State Government and Politics. A study of the historic development of state governments, their present organization and subdivisions, an their relation to each other. Special attention is given to the position of the state in the federal union through the study of federal-state, interstate, and state-loc relations. One course. *Leach*

230. American National Government. Formation and contemporar operation of the national political system; historical and behavioral approaches. On course.

241. Public Administrative Organization and Management. The Amer can administrative process: theory and practice of administrative organizatio and management. One course. *Hall*

243. Administrative and Organizational Theory and Behavior. Behavior analysis of public bureaucracies in the United States. One course. *Hawley*

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with speci attention to the powers, procedures, and judicial control of administrative agencie One course. *Hall*

246. Administration and Public Policy. The role of the administrative o ficial as a policy-maker in modern American politics. One course.

275. The American Party System. An intensive examination of selecte facets of American national political parties, such as relationships between presiden tial and congressional politics, the politics of national conventions, recent foreig policy and party alignments, and the controversy over party government. On course. *Kornberg*

279. The Legislative Process. An analysis of the structure and functior of Congress with emphasis on the behavior of legislators and resultant publ policy. Some consideration will be given to American state and foreign legislatures. One course. *Paletz*

285. The Judicial Process. A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisite: Political Science 127 or 207 or the equivalent. One course. *Fish*

291. Problems of Urban Government. Analysis of problems in the structure and functions of urban governments in the United States. One course. *Leach*

293. Federalism. Theoretical and operational aspects of federalism, with emphasis on their application in the American governmental system. One course. *Leach*

INTERNATIONAL LAW AND RELATIONS

120. Conflict Resolution: Problems of War and Peace. The causes and preconditions of human conflict including such factors as deprivation, elite misconceptions, national myths, and civil strife. Consideration of restraints to violent conflict such as negotiation and bargaining. Relevant contemporary international issues such as Vietnam are studied within the context of current social science research. One course. *Eldridge*

121. Elements of International Relations. The nature of international politics; the analysis of national power; the instruments of foreign policy; and the controls of state behavior. One course. *Ball and Eldridge*

122. Modern International Politics. An examination of the major problems of postwar international politics with particular attention to the extension of Soviet power, the Western response to this challenge, and the revolutions in the Afro-Asian world. One course. *Eldridge*

157. U. S. Foreign Policy. Principles and problems; changing concepts of diplomacy. One course.

158. Control of American Foreign Policy. A consideration of the forces which are responsible for the formulation of American foreign policy, and a study of the important factors which have influenced contemporary United States policy in the major areas of the world. The course includes an analysis of the respective roles of the President, Congress, Department of State, and the United Nations, as well as military and public opinion. One course. *Ball*

220. Problems in International Politics. Such topics as nuclear power, bipolarity and polycentrism, nationalism, national interests and ideology, the revolution of modernization, and regional integration. One course. *Kulski*

221. International Organization. Political and security functions of the United Nations and regional organizations. One course. *Ball*

226. Theories of International Relations. Contemporary theories of international relations and foreign policy. Emphasis on the interdependence of theory and empirical research. One course. *Eldridge*

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consul relations, treaties, treatment of aliens, pacific settlement of disputes, internation regulation of the use of force, and collective responsibility. One course. *Grzybows*

237. Problems in American Foreign Policy. The decision-making proce as applied to contemporary foreign policy issues. Prerequisite: Political Science 12 or the equivalent. One course. *Ball*

INDEPENDENT STUDY AND INTERNSHIPS

189, 190. Internship. Open to enrollment by students engaging in practic political or governmental work experience during the summer or a regular semester. To enroll a student must obtain the approval of the Director of Undergradua Studies, arrange employment, and secure the agreement of a departmental facul member to supervise a program of study related to the work experience. Tw courses.

191, 192. Independent Study. Directed reading and research. Open onl to qualified juniors by permission of the Director of Undergraduate Studies an of the individual instructor. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research. Open onl to seniors by permission of the Director of Undergraduate Studies and of the individual instructor. Two courses. *Staff*

UNDERGRADUATE SEMINARS

Intermediate Seminar. One hundred-level courses designated in the clas schedule with an *S* will be limited in enrollment to a maximum of fifteen student and conducted as seminars. Different courses will be so designated in different year Consult the official class schedule issued at the beginning of each semester fo those currently being offered.

Senior Seminars in Political Science. Prerequisites: Political Science 6 or 61D and one 100- or 200-level course in the field represented by the seminar and the consent of the instructor. Preference given to majors. Each seminar will n necessarily be offered every year. Consult the official class schedule.

200S A. Seminar in American Government and Politics. One course. *Sta*
200S B. Seminar in Comparative Government and Politics. One course *Staff*
200S C. Seminar in Political Theory. One course. *Staff*
200S D. Seminar in International Relations. One course. *Staff*

198. Seniors Honors Seminars. Open only to senior political scienc majors who are candidates for the degree with distinction. Preparation and writin of a research paper; group meetings to discuss common problems. Prerequisites Political Science 197 and the consent of the instructor. One course. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Political Science 61 or 61D. Seven courses in the d partment above 61 or 61D including two 200-level courses or 200-level seminar Majors must take at least one course in each of three fields. Four related course in departments approved by the political science adviser. Such courses are usuall aken in the Departments of Economics, History, Philosophy, Psychology, and Sociology.

Honors. Any student who is qualified (see the section on Honors in this *Bul-etin* for general requirements) may undertake work leading to a degree with dis-inction in political science by presenting himself to the Director of Undergraduate Studies as a candidate. In addition to meeting the normal requirements of a major n the department, the candidate for Graduation with Distinction must take Political Science 197 and 198. He must prepare a research paper on which he will be examined orally by a committee of three departmental faculty members.

Portuguese

For courses in Portuguese, see *Romance Languages.*

Psychology

Professor Jones, *Chairman;* Associate Professor Wing, *Director of Undergraduate Studies;* Professors Alexander, Borstelmann, Brehm, Carson, Diamond, Guttman, Lakin, Lockhead, Schiffman, Staddon, and M. Wallach; Associate Professors C. Erickson and R. Erickson; Assistant Professors Aderman, Coie, Conger, Costanzo, Eckerman, Hall, Kalat, Kremen, Norton, Robinson, and White; Lecturers Burkheimer, Casseday, Clifford, E. Crovitz, H. Crovitz, Davis, I. Gehman, Gentry, Kinsbourne, Krugman, Obrist, Peele, Shows, Somjen, Thompson, L. Wallach, nd Wolbarsht; Adjunct Instructor Musia Lakin; Research Associates S. Schiffman nd Monahan

70S, 71S. Freshman Seminars. Intensive experience through the study of one or two problems of special interest; does not fulfill departmental prerequisites. Prerequisite: departmental permission. Half-course or one course each. *Staff*

The following four first-level courses are open to second semester freshmen, ophomores, juniors, and seniors without prerequisite. Some of these courses will have discussion sections or preceptorials, with the availability of these experiences o be specified prior to registration. Students in each of these courses are expected to participate as subjects in 3-6 hours of psychological research. An individual student need fulfill this requirement only once, even though he takes more han one course at this level.

92. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherring-on) and behavioral (Pavlov). Complex organization: learning, perception, and ognition. One course. *Guttman, Lockhead, Schiffman, and Staddon*

93. Biological Basis of Behavior. Behavior as a product of evolution and he role of behavior in species survival. Neural and endocrine factors in reproduc-on, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Diamond, C. Erickson, and Kalat*

94. Personality. Representative theories of personality, from Freud to the resent, emphasizing problems of normal personality structure, dynamics, development, and assessment. Not open to students who have had Psychology 116. One ourse. *Alexander, Carson, and Kremen*

95. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence; special emphasis on personality and cognitiv development. One course. *Coie and Costanzo*

Intermediate and Advanced Lecture Courses. Some of these offerings wi include discussion sections or preceptorials, as specified prior to registratio

101. Social Psychology. Problems, concepts, and methods in the study o social interaction and interpersonal influence. Prerequisites: one course in psychology at the 90-level or permission of the instructor. One course. *Aderma and Jones*

110. Applied Psychology. Applications of psychology to problems of personnel selection, industrial efficiency, advertising, and selling. Prerequisites: on course in psychology. One course. *Staff*

117. Statistical Methods in Psychology. Elementary statistical technique and their application to the analysis and interpretation of psychological data. Theor of inference is stressed. Psychology majors only. One course. *Staff*

122S. Laboratory in Observation of Children. Aspects of cognition, personality, social development, and child-adult relationships. Open only to junior an senior psychology majors with the permission of the instructor. One course. *Musi Lakin*

126. Adolescent Psychology. Mental, social, and emotional developmen of adolescence and youth. Prerequisite: Psychology 95 or the equivalent. On course. *Staff*

132. The Psychology of Individual Differences. Nature and causes of individual and group variations in intelligence, special abilities, social and emotiona characteristics. Prerequisite: one course in psychology. One course. *Wing*

133. Biological Aspects of Learning. Prerequisite: Psychology 92 or 93 One course. *Kalat*

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes o understanding normal and abnormal personality development and functioning Prerequisite: Psychology 94 or 95. One course. *Carson*

139. Motivation. Contemporary use of such concepts as instinct, drive, an expectancy in the explanation of behavior; the role of nervous mechanisms an hormones in the control of goal-directed behavior. Prerequisite: Psychology 92 o 93. One course. *C. Erickson and R. Erickson*

Laboratory Courses (140 through 149). These courses are open chiefly t juniors and seniors. The subject matter varies, but these courses have in commo a concern with the design and execution of psychological experiments. Student will find them helpful as a means of gaining experience before engaging in independent study.

140S. Research Methods in Child Development. Replication of existing research paradigms, critique of representative studies, and formulation of new approaches; emphasis on the preschool child. Prerequisite: Psychology 95. One course. *Borstelmann and Coie*

141S. Tests and Measurements. Test methods used by psychologists to measure and evaluate mental processes. Prerequisite: Psychology 117 or the equivalent. One course. *Schiffman and Wing*

142S. Instrumental Behavior. Laboratory course using animal subjects in operant-conditioning situations. Prerequisite: Psychology 92. One course. *Guttman and Staddon*

143S. Experimental Methods in Cognitive Psychology. Human cognition; anguage, memory, problem-solving, and other higher mental processes. One course. *Staff*

144S. Learning and Adaptive Behavior. Basic principles of adaptive behavior in animals, with special emphasis on the effects of reinforcement. Participation in experiments with animals. Prerequisite: Psychology 92 or 93, or permission of instructor. One course. *Staddon*

145S. Experimental Approaches to Personality. Methods applied to personality research. Prerequisite: Psychology 94. One course. *Costanzo, Schiffman, and Wallach*

146S. Experimental Comparative Psychology. The bearing upon general psychological theory of experimental investigations of animal behavior in the fields of motivation and learning. Prerequisite: Psychology 92 or 93. One course. *C. Erickson and Kalat*

147S. Experimental Social Psychology. Group dynamics, attitude change, and interpersonal perception. Prerequisite: Psychology 101. One course. *Aderman, Brehm, and Jones*

148S. Psychology of Perception and Thinking. Basic phenomena of perception and thinking as determined by conditions in the external situation and in the person—biological and psychological. Prerequisite: Psychology 92. One course. *H. Crovitz and Lockhead*

149S. Physiological Psychology Laboratory. Neural bases of behavior, sensory and motor functions of the nervous system, and problems of emotion, motivation, and consciousness. Laboratory in psychophysics and the electrical activity of the nervous system. Prerequisites: Psychology 93, Physics 1-2, or Chemistry 1-2 and permission of the instructor. One course. *R. Erickson*

151S. Psychology and International Relations. Application of psychoogical theories to problems of international relations. Prerequisites: two courses in psychology and permission of instructor. One course. *Martin Lakin*

152S. Psychological Approaches to Contemporary Problems. Relevance of various psychological theories and findings to selected contemporary issues. Prerequisite: permission of the instructor. One course. *Staff*

165. Personality Theory. Theories of personality from larger metatheoretical perspectives. Open to junior and senior majors in psychology, or by permission of the instructor. Prerequisite: Psychology 94. One course. *Alexander or Kremen*

170S. A-D. Seminar in Selected Problems. One course each. *Staff*

Tutorial Study. For juniors and seniors. Small group discussions about influential books and articles in psychology. The availability of tutorials, their content, and their instructors will be announced before registration.

171T, 172T. Junior Tutorial. Prerequisites: Psychology 92 or 93, Psychology 94 or 95, and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

173T, 174T. Senior Tutorial. Prerequisites: Psychology 92 or 93, Psychology 94 or 95, Mathematics 32, 51, 133, 135, 136, or Psychology 117 or the equivalent, and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

177, 178. Independent Research. Admission to the course requires formulation of a study plan with a faculty supervisor and approval of the Director of Undergraduate Studies. Prerequisites: Psychology 92 or 93, Psychology 94 or 95, and one psychology course numbered 140 through 149; Mathematics 133 or Psychology 117 will be helpful. One or two courses. *Staff*

191, 192. Junior Independent Study and Research. Directed reading and research. Open only to highly qualified juniors who expect to graduate with distinction in psychology. Prerequisite: permission of the department. One or two courses. *Staff*

193, 194. Senior Independent Study and Research. Directed reading and research for seniors planning to graduate with distinction in psychology. Prerequisite: permission of the department. One or two courses. *Staff*

Courses at the 200-level are open to selected undergraduates with written permission of the instructor.

203. Sensation and Perception. Classical concepts in sensation and perception and the resulting psychophysical data for each of the major senses, with emphasis on vision and audition. One course. *Lockhead*

204. Comparative Psychology. Ontogeny, evolution, adaptive significance, and physiology of animal behavior. One course. *C. Erickson*

210. Cognition and Higher Mental Processes. An intensive analysis of the literature on thinking, problem-solving, creativity, language, and related topics. Emphasis is upon the functional significance of these aspects of intellectual activity and upon the experimental methodology involved in their study. One course. *Staff*

215. Developmental Psychology. Child behavior and development including personality, cognition, perception, and learning. One course. *Staff*

216. Biological Psychology. The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include: (*a*) the genetics of behavior (*b*) the organization of the dorsal thalamus and neocortex, and (*c*) the limbic system and hypothalamus. Methods covered include: (*a*) ablation method, (*b*) method of evoked potential, (*c*) electrical stimulation of the brain, and (*d*) classical and physiological genetics. One course. *Diamond*

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. One course. *Jones*

218. Research Methods in Social Psychology. Emphasis on the interplay between experimental design and technique. One course. *Aderman*

219. Physiological Psychology I. The structure and function of the nervous system as related to problems of sensory-motor processes and learning. One course. *R. Erickson*

220. Physiological Bases of Behavior. Emphasis on the neural, hormonal, and developmental bases of motivational behavior. One course. *C. Erickson*

234. Seminar in Personality. Selected research topics of current interest in experimental study of personality, including risk-taking, creativity, and cognitive styles. One course. *Wallach*

236. Theoretical Psychology. Representative systematic formulations and schools in historical sequence. One course. *Guttman*

238. Electroencephalogram and Psychological Function. A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, reaction time, and attention. Special emphasis is placed on the electrophysiology of conditioning and learning. Lectures, laboratory demonstrations, and clinical case presentations. One course. *Obrist*

239. Behavioral Correlates of Brain Damage in Man. Effects of brain damage on psychological functioning. Known brain-behavior relationships and problems encountered in the study of brain function. Laboratory demonstrations for assessment of cerebral dysfunction through the use of standard psychological tests. One course. *Thompson*

245. Personality Theory I. Representative theories of human functioning, from Freud to neoanalytic approaches. One course. *Alexander and Kremen*

246. Personality Theory II. Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. One course. *Alexander and Kremen*

271. A-D. Seminar in Selected Problems. One course each. *Staff*

273-274. Topics will include methods of data analysis, psychometric scaling, and test construction. Prerequisite: Mathematics 232 or equivalent. One course or two courses. *Schiffman*

282. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research are discussed as a means of introducing the student to the field. Emphasis is upon the application of principles drawn from theories of personality to individual and group psychotherapy. Discussions of selected readings and some field experience in therapy are included. One course. *Lakin and Carson*

283, 284. The History of Psychology. First semester: Aristotle to Kant; second semester: development of modern psychology. Prerequisite for 284: Psychology 283 or permission of instructor. One course or two courses. *Guttman*

291. Seminar in Community Mental Health. Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public health approach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning One course. *Staff*

293. Methods in Developmental Psychology. Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. One course. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Eight courses in psychology, including 92 or 93 and 94 or 95, Psychology 117, plus five additional psychology courses of the student's selection. Mathematics 32, 135, 136, Computer Sciences 51, or Management Science 60 may be substituted for Psychology 117 but do not count as a psychology course.

Students seeking a B.S. degree must complete, in addition to the above requirements, a minimum of four laboratory courses in the sciences and Mathematics 31 and 32, or their equivalent.

Public Policy Studies

Associate Professor Fleishman, *Director;* Assistant Professor Hawley, *Director of Undergraduate Studies;* Professor Estes (Medicine); Assistant Professors Bell (Law), Graham (Economics), and Scheffler (Economics); Instructors Payne and Vaupel

The major in public policy studies is offered through the Institute of Policy Sciences and Public Affairs. The course of study stresses the development of analytical and problem solving skills that cut across several academic disciplines and can be applied in a broad range of public policy areas. In addition, students in the major are expected to develop an in-depth knowledge of one or more general areas of public policy (e.g., health, communications, criminal justice, education, etc.).

The aim of the major is to furnish students with a firm background in the social sciences and with sufficient competence in analytical and quantitative methods to qualify them for professional school, graduate study, or staff positions in public service. At the same time, the Institute of Policy Sciences and Public Affairs believes that policymakers must be able to put public issues in their historical perspective and to see the social and philosophic, as well as quantifiable, dimensions of problems. Thus, majors will be encouraged to choose related work in fields such as sociology, psychology, history and ethics, and to participate actively in numerous programs offered at the Institute which aim at augmenting formal course work. A senior seminar permits majors to gain facility in the use of their analytical skills by pursuing research on selected topics in public policymaking and analysis.

Courses in public policy studies are open to all students providing that the prerequisites cited for individual courses are met. Majors are given preference in admission to internship courses.

55. Introduction to Analytical Methods for Public Policymaking: Structuring Policy Problems. Defining public policy problems, identifying objectives, and evaluating costs and benefits. Uses and limitations of decision analysis in selecting among alternatives. One course. *Vaupel*

110. Economic Analysis for Public Policymaking: Microeconomic and Non-Probabilistic Models. Survey and application of analytical tools required for understanding public policy problems. (Also listed as Economics 161.) One course. *Graham*

112. Advanced Analytical Methods for Public Policymaking: Probabilistic Models. Basic probability concepts: uncertainty, contingency, variability, distribution, and probability assessments. Models of estimation using abundant data and "guesstimation" using sparse data. One course. *Vaupel*

114. Political Analysis for Public Policymaking. Analysis of the political and organizational processes which influence the formulation and implementation of public policy. Alternative explanatory models. (Also listed as Political Science 145.) One course. *Hawley*

116. Policy Choice as Value Conflict. The normative dimensions of public policy. Analysis of cases in selected policy areas, including the space program, poverty, ecology, and higher education. Instructor's permission required except for those majoring in public policy studies. One course. *Payne*

120S. The Humanistic Study of Society. Prerequisite: consent of the instructor. One course. *Payne*

INTERNSHIP COURSES

The Institute internship courses provide students with an opportunity to develop a basic understanding of one or more public policy areas, to test that understanding "on-the-job" during the summer (stipends are provided), and to return to the classroom to build on this knowledge and experience. Except under unusual circumstances, students must take the entire course sequence to receive credit for any part of an internship course. Students interested in internships in other policy areas, such as education, the arts, urban planning and development and transportation, should contact the Director of Undergraduate Studies in Public Policy. The following internship courses are offered for 1973-74.

151S, 152S-153S. Administration of Justice. Analysis of the policy problems and conflicts involved in the operation of the criminal justice system. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructors' permission required except for those majoring in public policy studies. (Also listed as Political Science 111S, 112S-113S.) *Staff*

154S, 155S-156S. Communications Policy. Considerations and analysis of the policy problems and conflicts involved in governmental regulation of the media of communication. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructors' permission required except for those majoring in public policy studies. (Also listed as Political Science 114S, 115S-116S.) *Staff*

157S, 158S-159S. Health Policy. Analysis of health care problems and policies. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructors' permission required except for those majoring in public policy studies. (Also listed as Economics 176S, 177S-178S.) *Scheffler, Estes, and Staff*

160S, 161S-162S. Environmental Policy. Analysis and evaluation of the policy problems and conflicts which result from human interaction with the environment. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructors' permission required except for those majoring in public policy studies. (Also listed as Economics 166S, 167S-168S.) *Staff*

180S, 181S-182S. Transportation Policy. Prerequisite: consent of instructor. (Also listed as Engineering 180S, 181S-182S.) Three courses. *Dev Garg and Staff*

DEPARTMENTAL MAJOR

Prerequisites. Mathematics 31 or 51; Economics 1 or 51 and 2 or 52; and Public Policy Studies 55.

Major Requirements. Public Policy Studies 110, 112, 114, 116, and a senior seminar, plus one internship course.

Religion

Professor Poteat, *Chairman;* Associate Professor Kort, *Director of Undergraduate Studies;* Professors Bradley, Jones, Osborn, Phillips, and Price; Associate Professors Clark, McCollough, Meyers, Partin, and Wintermute; Assistant Professors Burford, Charlesworth, and Lawrence; Visiting Assistant Professors Johns and Liebowitz; Instructor Corless; Lectures Jenks, Little, and Shows

The academic study of religion is integral to a liberal education. The curriculum is determined by the subject around which the department is formed, by the various areas and methods for the study of religion, and by the department's desire to increase and discipline the students' understanding of and appreciation for those religious phenomena and problems brought into focus by each area and method.

In addition to Biblical studies and studies in Christian history, ethics, and theology, the department offers courses in Judaic and non-Western religious studies as well as courses of a substantially interdisciplinary character (religion and the social sciences and religion and the humanities).

Courses numbered below 100, with the exception of Religion 70S and Religion 71S, are open to all students. Religion 70S and 71S are freshman-sophomore seminars. (The specific topics for these seminars and the names of instructors will be announced prior to registration.) One-hundred-level courses are open to juniors and seniors without prerequisite except in the cases in which the requirement of permission of the instructor is stated at the end of the course description. Freshmen and sophomores who have completed one course below 100 may be admitted to 100-level courses with the exception of junior-senior seminars. (The topics for these seminars and the names of the instructors will also be announced prior to registration.)

50. The Old Testament. Historical, literary, and theological investigations. Not open to students who have had Religion 55 or 55D. One course. *Staff*

52. The New Testament. Origins, development, and content of thought. Not open to students who have had Religion 55 or 55D. One course. *Staff*

55. The Religion of the Bible. An historical, cultural, and theological study of the Old and New Testaments. Not open to students who have had Religion 50, 50D, 52, or 52D. One course. *Staff*

50D, 52D, 55D. Same as 50, 52, 55 with discussion section included. One course. *Staff*

57. Introduction to the History of Religions. Historico-religious study of primitive religions, Hinduism, Buddhism, Islam, and other religions. One course. *Staff*

59. Problems in Theology and Ethics. Philosophical, theological, and cultural problems, such as the existence of God, ethical theory, religious language, and the relation of religion to culture. One course. *Staff*

70S, 71S. Freshman-Sophomore Seminars: Religious Studies. Topics and instructors to be announced. Two courses.

BIBLICAL STUDIES

101D. Principles of Archaeological Investigation. Supervised field work, visits to other excavations, introduction to ceramic chronology, numismatics, and other related disciplines. Excavation of the late Roman village of Khirbet Shema, Galilee. Offered in Israel, only in the summer. One course. *Meyers*

102D. Palestine in Late Antiquity. The history, literature, and archaeology of Roman Palestine with particular emphasis on Galilee in rabbinic and early Christian times. One course. *Meyers*

104. The Prophets of the Old Testament. Their historical setting and message. One course. *Wintermute*

105. Theology of the Old Testament. Emphasis upon history and eschatology, covenant, messianism, and wisdom; evaluation of Eichrodt, Jacob, and von Rad. One course. *Jenks*

106. Jesus and the Synoptic Gospels. The gospel tradition in the New Testament. One course. *Charlesworth and Price*

107. Theology of the New Testament. A systematic analysis of the theologies of the New Testament writers and an attempt to synthesize the basic and shared themes. One course. *Charlesworth and Price*

108. The Life and Letters of Paul. Paul's role in the expansion of the Christian movement, the most important aspects of his thought, and his continuing influence. One course. *Charlesworth and Price*

111. The Historical Jesus. Historical research on the life of Jesus. One course. *Charlesworth and Price*

195A, 196A. Junior-Senior Seminars: Biblical Studies. Topics and instructors to be announced. Two courses.

Students interested in acquiring the linguistic tools required for graduate courses in Biblical Studies are referred to the offerings of the Classics Department in this *Bulletin* for Elementary Greek and the *Divinity School Bulletin* for courses in Biblical Hebrew and Aramaic.

STUDIES IN CHRISTIAN LIFE AND THOUGHT

120. History of the Christian Church. Crucial events, issues, forms, and writings that have shaped the Christian community and influenced Western civilization from the time of the early church. One course. *Jones*

124. Christianity in America. Representative men, movements, and thought in American Christianity. One course. *Jones*

125. Religion and Theology of Black America. Black religion in its historical and social context, with critical appraisal of major works. One course. *Burford*

126. Themes in Christian Theology. Study of Christian teachings concerning God, Jesus Christ, sin, and salvation, intended to serve as a basis for the student's evaluation of his own religious concepts. One course. *Osborn*

128. The Background of Contemporary Christian Thought: 1918-1950. Theology of Karl Barth, Rudolf Bultmann, Paul Tillich, Karl Rahner, Reinhold Niebuhr, and others. One course. *Osborn*

129. The Frontiers of Contemporary Christian Thought. Radical and prophetic movements as represented by Dietrich Bonhoeffer, Harvey Cox, Leslie Dewart, Jurgen Moltmann, and others. One course. *Osborn*

130. Christian Ethics. Ethical implications of Biblical religion, the historical development of the Christian ethics, and the ethical dimensions of contemporary social life. One course. *Clark and McCollough*

138. Existentialism. Religious roots, development, and contemporary expressions. One course. *Burford*

195B, 196B. Junior-Senior Seminars: Studies in Christian Life and Thought. Topics and instructors to be announced. Two courses.

HISTORY OF RELIGIONS

140. Religions of India. Major religious traditions of the sub-continent. Hinduism, Buddhism, Jainism, and Islam. One course. *Lawrence*

141. Religions of China and Japan. Traditional religion in China and Japan and its interaction with Sino-Japanese Buddhism. One course. *Corless*

142. Myth and Symbol. Historical and phenomenological study of religious myths and symbols, Christian and non-Christian. One course. *Partin*

143. Mysticism. The mystical element in religion: Hinduism, Buddhism, Christianity, and Islam. One course. *Bradley*

144. The Foundations of Post-Biblical Judaism. History, religion, and literature of Pharisaic and sectarian Judaism from the time of Ezra to Rabbi Judah. One course. *Meyers*

145. Religious Quests of the Greco-Roman World. Sectarian Judaism, the Mystery Cults, and Gnosticism. One course. *Wintermute*

146. Contemporary Jewish Thought. Modern Jewish thought from Mendelsohn to the present, with particular reference to American thinkers. One course. *Meyers*

147. Muhammad and the Qur'ān. The *Qur'ān* in relation to the religious experience, life, and work of Muhammad. One course. *Partin*

149. Buddha and Buddhism. A systematic introduction to the origins and spread of Buddhist thought and practice. One course. *Corless*

195C, 196C. Junior-Senior Seminars: Judaic Studies. Topics and instructors to be announced. Two courses.

195D, 196D. Junior-Senior Seminars: History of Religions. Topics and instructors to be announced. Two courses.

113. African Philosophy. (Also listed as Black Studies 113.) One course. *Olela*

RELIGION AND THE SOCIAL SCIENCES

150. Religion and Human Sexuality. A study of the current "sexual revolution" with the aim of examining options and determining relevant Judaic and Christian attitudes and actions. One course. *Phillips*

151. Ethical Issues in Social Change and Public Policy. American moral tradition and factors in social change in the normative analysis of public policy, with a consideration of specific ethical issues. One course. *McCollough*

154. Ethics and Modern Technology. Emerging ethical issues created by the impact of technology on the psychological, social, political, and economic life of modern man. One course. *Clark*

155. Ethical Issues in the Life Cycle. Human development viewed in religious, ethical, and psychological perspectives. One course. *McCollough*

156. Christian Marriage and the Family. Marriage and the family in American society studied from the Christian perspective. Attention will be given to the teachings of the churches and of psychologists and sociologists concerning courtship and marriage, sex, parent-child relationships, mixed marriages, and divorce. One course. *Phillips*

158. Psychology and Religion. Contributions of major psychological theories to an understanding of religion, especially Christianity. One course. *Shows*

195E, 196E. Junior-Senior Seminars: Religion and the Social Sciences. Topics and instructors to be announced. Two courses.

RELIGION AND THE HUMANITIES

170. Problems of Religious Thought. Analysis of credentials for belief in God. One course. *Poteat*

174. Religion and The Poetics of Vision. The liturgical shaping of life as embodied in selected works of painting and sculpture. One course. *Poteat*

187. Religious Elements in Classical and European Literature. A consideration of the religious elements in representative writings. One course. *Kort*

188. Recent Literature and its Religious Implications. Religious elements in recent literature. One course. *Kort*

195F, 196F. Junior-Senior Seminars: Religion and the Humanities. Topics and instructors to be announced. Two courses.

INDEPENDENT STUDY

191, 192. Independent Study. For freshmen and sophomores with departmental approval. Two courses. *Staff*

193, 194. Independent Study. For juniors and seniors with departmental approval. Two courses. *Staff*

FOR SENIORS AND GRADUATES

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. One course. *Lawrence*

218. Religion in Japan. A survey of religion in Japan, with specific emphasis on indigenisation and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. One course. *Corless*

228. Theology of the Gospel and Epistles of John. A study of the origin of these writings, the provenance of their thought forms and symbolism, their influence on the early church, and their contemporary significance. One course. *Price*

232. Religion and Literature: Perspectives and Methods. Selected literary works as interpreted by myth or archetype critics and by theological critics. One course. *Kort*

233. Modern Narrative and Religious Language. Fiction of selected American, British, and continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. One course. *Kort*

248. Theology of Karl Barth. An historical and critical study of Barth's theology. One course. *Osborn*

249. Doctrine of The Church in Contemporary Theology. One course. *Osborn*

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. One course. *Partin*

281. Phenomenology and Religion. Scheler, E. Straus, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. One course. *Poteat*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions, with particular attention to religious pilgrimage. One course. *Partin*

283. Religions of East Asia. Major traditions of China and Japan; emphasis on Buddhism. One course.

284. The Religion and History of Islam. Origins and development of the Islamic community and tradition, with particular attention to the religious element. One course. *Partin*

285. The Vedic Tradition: Compilation and Interpretation. Indian canonical writings with emphasis on the literary stages in relation to later philosophical and religious movements. One course. *Lawrence*

286. Religious Trends in Modern India. Leaders and movements among the religions from the coming of the Europeans to Independence. One course. *Bradley*

287. The Scriptures of Asia. Translations of basic texts from the religious traditions of India, China, and Japan. One course. *Bradley*

288. Buddhist Thought and Practice. An historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. One course. *Corless*

289. World Religions and Social Change. The contemporary role of Buddhism, Christianity, and Islam in Asia and Africa. One course. *Bradley*

293. Sociological Analysis of Religion. Components of a religion (belief-systems, liturgical practices, ethical teachings, institutional structure, and modes of operation) as they function in relation to social cohesion, social conflict, and social reform. One course. *Clark*

294. Institutional Analysis of Religious Bodies. Internal structure and dynamics of religious groups. One course. *Clark*

295. Ethics and Economic Life. Historical teachings of the Christian churches in the area of economic life, contemporary norms of economic justice, and current public and private economic policies and policy-making processes. One course. *Clark*

DEPARTMENTAL MAJOR

Major Requirements. Seven courses, which must include one course in each of at least three of the five areas of the curriculum (it is recommended that Biblical studies and history of religions be two of these three areas). The seven courses must include two courses at the introductory level (50, 52, and 55 in the area of Biblical studies; 57 in history of religions; 59 may count in any of the three remaining areas) and a junior-senior seminar or a 200-level course.

Reserve Officers Training Program

AIR FORCE AEROSPACE STUDIES

Professor Knops, Lt. Colonel, USAF, *Chairman;* Associate Professor Lohner, Major, USAF, *Director of Undergraduate Studies;* Assistant Professor Weeks, Captain, USAF, *Supervisor of Freshman Instruction*

Eligibility Requirements. All freshmen, male or female, are eligible to enroll in the General Military Course in the Air Force ROTC. For enrollment in the Professional Officer Course, the student must have completed successfully either the General Military Course or the six weeks Field Training Course; must execute a written agreement with the government to complete the Professional Officer Course; must be sworn into the Enlisted Reserve; and he must agree to accept a commission in the United States Air Force Reserve upon graduation.

Deposit. Each student must make a deposit of $10.00 with the Bursar's Office to ensure the return of all government property.

General Military Courses

First Year

1. Defense of the United States. A study of the causes of world conflict, the problem of United States security, and the role of the armed forces as instruments of national policy. (May not be counted to satisfy graduation requirements.) Half-course. *Lohner*

4. Corps Training. No course credit. *Staff*

Second Year

51. World Military Systems. A comparative study of free world military forces, Communist military systems, and trends in the development and employment of military powers. (May not be counted to satisfy graduation requirements.) Half-course. *Lohner*

54. Corps Training. No course credit. *Staff*

Professional Officer Courses

All students selected to continue aerospace studies pursue the following courses:

First Year

101S. Space Technology. Development of space technology, ramifications of space travel, and the influence of space technology upon world affairs. One course. *Weeks*

102. Military History, War, Politics, and Technology. (Also listed as History 149.) One course. *Ropp*

104. Corps Training. No course credit. *Staff*

Second Year

201S. Concepts of Leadership. Principles and research of leadership, to include military law. One course. *Knops*

202S. Concepts of Management. Functions of management and their application to duties as junior officers/executives. One course. *Knops*

203. The Problems of Flight and Aerospace Sciences of Weather and Navigation. Mandatory for pilot and navigator cadets, approval of instructor for all others. Half-course. *Lohner*

204. Corps Training. No course credit. *Staff*

NAVAL SCIENCE

Professor Klause, Captain, U.S. Navy, *Chairman;* Visiting Associate Professor Banks, Commander, U.S. Navy, *Director of Undergraduate Studies;* Visiting Assistant Professors McDonnell, Lieutenant Commander, U.S. Navy; Mann, Lieutenant Commander, U.S. Navy; Acree, Major, U.S. Marine Corps; Gravatt, Lieutenant, U.S. Navy; Rivers, Lieutenant, U.S. Navy

Completion of all naval science courses listed is required for a commission. A maximum of four naval science courses may be offered as electives in satisfying degree requirements in Trinity College; only two naval sciences courses (junior or senior level) can be so offered in the School of Engineering. Fifteen hours of practical and applied leadership are required each semester.

11. Naval Orientation. Military formations, movements, commands, courtesies, and honors; and elements of unit leadership. *Mann*

12. Naval Ships Systems. Structure, elements of design, stability, control compartmentation, communications, and propulsion systems as they bear on safe operation and combat or service effectiveness. One course. *Mann*

51. Seapower and Maritime Affairs Seminar. Strategic, tactical, and diplomatic aspects of seapower. *Rivers*

52. Seapower and Maritime Affairs Seminar. Strategic, tactical, and diplomatic aspects of seapower. *Rivers*

125P. Naval Organization and Management. Naval lines of command and control; organization for logistics, service, and support; research on the practical application of fundamental management principles at lower echelons of Navy management structure. (Required preceptorial for NROTC students taking Management Sciences 125.) No course credit. *McDonnell*

126. Concepts and Analyses of Naval Tactical Systems. One course. *Mann*

126L. Naval Ship Administration Laboratory. *McDonnell*

131. Navigation. Theory, principles, and procedures of ship navigation, movements, and employment. Dead reckoning, piloting, and electronic and celestial navigation. One course. *Eisenhardt*

131L. Navigation Laboratory. Practical application of the theories and principles of navigation as presented in the lecture series. *Eisenhardt*

132. Naval Operations. Components of general naval operations, including concepts and application of tactical formations and dispositions, relative motion, maneuvering board and tactical plots, rules of the road, and naval communications. One course. *Eisenhardt*

141. Evolution of Warfare. A survey of the development of weaponry, tactics, and strategy affiliated with warfare, as exemplified by confrontations selected for detailed study through World War II. One course. *Acree*

151. Amphibious Operations. An examination of the development of U. S. amphibious doctrine, with emphasis on current applicability of that doctrine. *Acree*

Romance Languages

Professor Fein, *Chairman;* Assistant Professor Bryan, *Director of Undergraduate Studies in French;* Professor Davis, *Director of Undergraduate Studies in Spanish;* Associate Professor Hull, *Supervisor of Language Instruction;* Professors Cordle, Fowlie, Niess, Predmore, Tetel, and Wardropper; Associate Professors Ripley, Stewart, and Vincent; Assistant Professors Alstad, Auld, Barlow, Caserta, Landeira, Miller, and Murray; Instructor Steegar

French 63-64 and Spanish 63-64 or equivalent are the prerequisites for all elective courses. Students who, by reason of foreign residence, have had special opportunities in French or Spanish must be classified by the appropriate director of undergraduate studies.

In addition, students who elect French 91, 92, 93S, 94S, or Spanish 91, 92, 93S, or 94S may use any of these courses to fulfill the divisional requirement in humanities.

FRENCH

1-2. Elementary French. Understanding, speaking, reading, and writing French. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Hull and Staff*

63. Intermediate French. Intensive grammar review and training in reading; laboratory practice. One course. *Staff*

64. Intermediate French. Open to students who have passed French 63 or by special placement. Readings in contemporary literature; practice in composition. One course. *Staff*

76. Introductory French Conversation. Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Limited to fifteen students. One course. *Staff*

100. Active French. Intensive instruction in oral and written expression. Prerequisite: French 76 or equivalent. Limited to fifteen students. One course. *Bryan and Staff*

101, 102. Introduction to French Literature. An introduction to the major writers of the French literary tradition. Selections and complete works of poetry, fiction, theater, and essay. In the first semester: Middle Ages through the eighteenth century. In the second semester: nineteenth and twentieth centuries. Lectures and discussions; short essays and tests. Conducted in French. Two courses. *Fowlie and Staff*

103S. French Literature. Topics to be announced. Fall semester. Open to freshmen and sophomores. One course. *Staff*

104S. French Literature. Topics to be announced. Spring semseter. Open to freshmen and sophomores. One course. *Staff*

105. Explication de Textes. A study of the French method of textual analysis, with selections primarily from nineteenth and twentieth century authors. For students who have taken 91 and 92. One course. *Staff*

106S. Montaigne. A close reading of selected *Essais* aiming to integrate themes, structure, and style; frequent comparative allusions will be made to Proust, Pirandello, Malraux, and Sartre. One course. *Tetel*

107. Masterworks of French Literature. An intensive study of selected works of French literature with special emphasis on developing critical techniques. Open only to freshmen, through the Advanced Placement Program or by invitation of the department. One course. *Staff*

108. French Romanticism. The beginnings of the modern era, in its quest for new values and a new expression, as studied through the great lyric poets and prosodists of the first half of the nineteenth century. Readings from Chateaubriand, Lamartine, Musset, Hugo, Vigny, and others. One course. *Staff*

109. Toward Modernism in French Poetry. An introduction to modern trends in the nineteenth century; emergence from traditional Romanticism; Art for Art's Sake and the Parnassians (Gautier, Leconte de Lisle); the transition from Decadence to Symbolism (Baudelaire, Verlaine, Rimbaud, and Mallarmé). One course. *Barlow*

110. French Comedy in the Seventeenth and Eighteenth Centuries. One course. *Stewart*

111. French Drama of the Nineteenth Century. A survey of the French theatre from the Romantic period to the *Theatre libre*. One course. *Staff*

112. French Drama of the Twentieth Century. Reading of representative plays selected from the works of Bernstein, Maeterlinck, Romains, Sarment, Vildrac, J. J. Bernard, Claudel, Lenormand, Pagnol, Giraudoux, Anouilh, and others. One course. *Staff*

113. Society and the Novel under the Ancien Regime. The novel as an expression of social consciousness. Readings include Prevost, Montesquieu, Marivaux, Diderot, Laclos. No knowledge of French required. One course. *Stewart*

114S. The Sixteenth Century. An introduction to the spirit of the French Renaissance as reflected in the literature of the age of Rabelais and Montaigne, Ronsard, and Du Bellay. One course. *Vincent and Tetel*

115. The Nineteenth-Century Novel. Intensive study of selected novels from the works of Stendhal, Balzac, Flaubert, and Zola. Not open to students taking French 221 or 222. One course. *Staff*

117S. Masterpieces of French Medieval Literature. Lyric poetry, epic, romance, and theater from beginning to the middle French period. One course. *Ripley*

119. French Drama of the Seventeenth Century. The plays of Corneille, Racine, and Moliere are used to explore tragedy and comedy. One course. *Auld*

120. Seventeenth-Century Poetry, Novel, and Rhetoric. Analysis of form and thought in selected works of La Fontaine, Mme. de La Fayette, Pascal, La Rochefoucauld, and La Bruyere. One course. *Auld*

121. The French Enlightenment. Religion, politics, and philosophic and literary ideas of eighteenth century France. Montesquieu, Voltaire, Rousseau, and others. One course. *Alstad*

122. The Novel in the Eighteenth Century. Theory and practice of prose fiction as seen in selected works of Marivaux, Prevost, Diderot, Rousseau, and Laclos. One course. *Alstad and Stewart*

126. French Phonetics. Sounds, rhythm, intonation. Individual practice in language laboratory. Readings in phonetic theory. One course. *Hull and Steegar*

127. Advanced Composition and Conversation. A systematic review of grammar; frequent oral and written reports. Attention to the problems of pronunciation and diction. Prerequisite: French 97 or consent of the instructor. One course. *Bryan*

129. French Civilization. Contemporary France as seen through its history, institutions, customs, and arts. Reading and discussion in French. One course. *Staff*

132. French Poetry of the Twentieth Century. The symbolist heritage and surrealism. One course. *Barlow*

133, 134. Contemporary French Life and Thought. Major writers of the twentieth century and their historical and cultural circumstances. First semester: Claudel, Gide, Valery, Proust, Apollinaire, Mauriac, Romains, Cocteau. Second semester: Giono, Breton, Aragon, Malraux, Sartre, Beckett, Camus, Robbe-Grillet. Two courses. *Cordle*

150T. Tutorial in Composition. Half-course. *Hull and Staff*

151. Theory and Form of Tragedy. (Also listed as Comparative Literature 151.) One course. *Fowlie*

181, 182. French. An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Ripley*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors by permission of the department. Two courses.

193, 194. Independent Study. Directed reading and research. Open only to highly qualified seniors by permission of the department. Two courses.

209. Advanced Composition and Syntax. Comparative English-French stylistics. Practice in controlled and free writing. One course. *Hull*

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. One course. *Hull*

213. French Literature of the Seventeenth Century. Its initial phase. Readings in the major literary works to the middle of the century. One course. *Auld*

214. French Literature of the Seventeenth Century. Its "classical" phase. Readings in the major literary works from the middle to the end of the century. One course. *Auld*

217. French Symbolism. Poetry and theories of Baudelaire, Mallarmé, and Rimbaud; Decadence; Lautréamont and Laforgue. One course. *Fowlie*

219. Old French Literature. An introduction to the reading of medieval French literary texts. One course. *Vincent*

221, 222. The Nineteenth-Century French Novel. First semester: Romanticism and Romantic realism, studied especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and naturalism, with special emphasis on Flaubert and Zola. One course. *Niess*

223. French Literary Criticism. A history of critical theory in France and a study of the major critics from the Renaissance to today. One course. *Fowlie*

224. History of the French Language. The evolution of French from Latin to its present form; integral developments and external influences. One course. *Hull*

225, 226. From Renaissance to Baroque in French Literature of the Sixteenth Century. First semester: literary prose. Readings from Jean Lemaire de Belges, Marguerite de Navarre, Rabelais, Montaigne, and others. Second semester: poetry and theater. Readings from Marot, Sceve, Labe, Saint Gelais, the Pléiàde, d'Aubigné, Sponde, Due Bartas, Garnier, and others. Two courses. *Tetel*

228. French Poetry of the Twentieth Century. In the wake of symbolism: Valery and Claudel; poetry as ritual: Peguy; Apollinaire and surrealist poetry; the contemporary movement: Michaux, Char, Saint-John Perse. One course. *Fowlie*

233. Contemporary French Theatre. A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. One course. *Fowlie*

234. Proust. A study of *A la recherche du temps perdu.* The thematic structure and the aesthetics of the work. One course. *Fowlie*

241, 242. French Literature and Thought in the Age of Enlightenment. First semester: the new philosophy and its propagation. Second semester: the crisis in literary aesthetics. Two courses. *Staff*

245. French Literature of the Twentieth Century: to 1935. Emphasis on Gide, Mauriac, and Malraux. One course. *Cordle*

246. French Literature of the Twentieth Century: after 1935. Emphasis on Sartre, Camus, and the *nouveau roman.* One course. *Cordle*

ITALIAN

1-2. Elementary Italian. Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Alstad and Staff*

63. Intermediate Italian. Intensive grammar review and training in reading; laboratory practice. One course. *Caserta and Staff*

64. Intermediate Italian. Open to students who have passed Italian 63 or by special placement. Readings in contemporary literature; practice in composition. One course. *Caserta and Staff*

97. Spoken Italian. Intensive instruction in contemporary Italian using selected topics and readings to build vocabulary and to provide practice in structural patterns. One course. *Caserta*

101, 102. Masterworks of Italian Literature in English Translation. First semester: from the origins to the Baroque. Second semester: Ottocento and Novecento. Two courses. *Caserta*

129. Modern Italy. Political, social, economic, and cultural problems in Italian history from 1861 to the present day. One course. *Caserta*

181, 182. Italian. Intensive introduction to the language. Modern readings. Completion of the second year of another foreign language will normally be required as a prerequisite. Two courses. *Tetel and Caserta*

183, 184. Readings in Italian Literature. Historical and critical analysi First semester: Dante, Petrarch, Boccaccio, and the Humanists. Second semeste Foscolo, Manzoni, Leopardi, and Verga. Conducted in Italian. Two course *Caserta*

191, 192. Independent Study. Directed reading and research for junior Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for senior Two courses. *Staff*

283. Italian Novel of the Novecento. Representative novelists from Svev to the most recent writers. One course. *Caserta*

284. Dante. *La Vita Nuova* and a close reading of the *Inferno*. The cours will be conducted in English. Reading in Italian or English. One course. *Fowli*

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. One course *Tetel*

PORTUGUESE

181, 182. Portuguese. Intensive introduction to the language. Moder readings. Completion of the second year of another foreign language will normall be required as a prerequisite. Two courses. *Miller*

183. Readings in Modern Brazilian Literature. Prerequisite: Portugues 181-182 or permission of the instructor. One course. *Miller*

184. Literature of the Explorations: Asia, Africa, Latin America. Prerequisite: Portuguese 181-182 or permission of the instructor. One course. *Mille*

185, 186. Conversation. Intensive practice in spoken Brazilian Portuguese. Prerequisite: Portuguese 181, 182 or permission of the instructor. Half-course. *Miller*

SPANISH

1-2. Elementary Spanish. Understanding, speaking, reading, and writing Spanish. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Miller and Staff*

63. Intermediate Spanish. Intensive grammar review and training in reading, laboratory practice. One course. *Landeira and Staff*

64. Intermediate Spanish. Open to students who have passed Spanish 63 or by special placement. Readings in contemporary literature; practice in composition. One course. *Landeira and Staff*

76. Introductory Spanish Conversation. Practice in everyday conversational Spanish. Prerequisite: Spanish 63 or equivalent. Limited to fifteen students. One course. *Staff*

100. Active Spanish. Intensive instruction in oral and written expression. Prerequisite: Spanish 76 or equivalent. Limited to fifteen students. One course. *Staff*

101, 102. Introduction to Spanish Literature. An introduction to the major writers of the Spanish literary tradition. Selections and complete works of poetry, iction, theater, and essay. First semester: Middle Ages through the eighteenth cenury. Second semester: nineteenth and twentieth centuries. Conducted in Spanish. Prerequisite: Spanish 63-64 or equivalent. Two courses. *Staff*

103S. Spanish Literature. Topics to be announced. Fall semester. Open to reshmen and sophomores. One course. *Staff*

104S. Spanish Literature. Topics to be announced. Spring semester. Open o freshmen and sophomores. One course. *Staff*

117S. Masterpieces of Spanish Medieval Literature. Selected works of the Medieval period. One course. *Murray*

141S. Spanish Literature. Topics to be announced. Fall semester. Open o juniors and seniors. One course. *Staff*

142S. Spanish Literature. Topics to be announced. Spring semester. Open o juniors and seniors. One course. *Staff*

150T. Tutorial in Composition and Syntax. Half-course. *Staff*

152. Issues and Problems in Twentieth Century Spanish America. Revolution, national identity, myth and reality of *caudilloism,* imperialism, ideology eft and right, and nationalism. Readings in English or Spanish. (Also listed as History 152.) One course. *Fein and TePaske* (History)

155. Spanish American Short Fiction. Novelettes and short stories of the wentieth century. One course. *Fein*

156. The Spanish American Novel. Masterworks of the nineteenth and wentieth century. One course. *Fein*

157. Latin American Literature in Translation. One course. *Fein*

161. Spanish Literature of the Renaissance and the Baroque. A study of selected works of the sixteenth and seventeenth centuries with attention to their reflection of social, religious, and political ideas. One course. *Miller and Wardropper*

162. Spanish Romanticism. A study of the romantic spirit in modern Spanish literature. One course. *Davis*

163. The Generation of 1898. Special emphasis on the novel and essay. The precursors: "Clarin" and Ganivet; Unamuno, Baroja, "Azorin," Valle-Inclan; influence on the next generations; Perez de Ayala and Ortega y Gasset. One course. *Predmore and Landeira*

164. Topics of Spanish Civilization. A humanistic study of Spain as a nation through its history, culture, people, and institutions. One course. *Landeira*

165S. Analysis of Great Spanish Authors. A close textual study of a few literary texts with some considerations of methods of literary criticism. The course is designed to give the student insight into various ways of interpreting and understanding literary works so that his experience of literature in general may be enriched. One course. *Wardropper*

166. Spanish Realism. The growth of realism in Spanish literature c the nineteenth century. One course. *Davis*

167. Golden Age Literature: Cervantes. Emphasis on *Quijote*. One cours *Predmore*

168. Survey of Eighteenth Century Spanish Literature. Prose, poetry and drama reflecting social, religious, and political ideas of the eighteenth century One course. *Staff*

169. Literature of Contemporary Spain. Trends in the post-Civil Wa novel, theater, and poetry. One course. *Landeira*

170. The Picaresque Novel. One course. *Murray*

176. Advanced Conversation. This course is designed to develop facilit of expression through constant drill on vocabulary and conversational idiom. Tim will be devoted to a review of the essentials of Spanish syntax. Prerequisite: Spanis 97 or permission of the instructor. One course. *Landeira and Staff*

177. Advanced Composition and Syntax. Fundamental difficulties i the language; practice in writing idiomatic Spanish; exercises in translation from English to Spanish. For students who have a satisfactory command of Spanis grammar and fair conversational ability. Prerequisite: Spanish 176 or permission. One course. *Davis*

181, 182. Spanish. An intensive introduction to the language open only t students who have achieved proficiency in another language. Two courses. *Mille*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors by permission of the department. Two courses.

193, 194. Independent Study. Directed reading and research. Open only to highly qualified seniors by permission of the department. Two courses.

251. The Origins of the Spanish Novel. A critical study, based on close readings and discussions, of selected examples of the principal genres of the early novel: *Amadis de Gaula*, Diego de San Pedro's *La carcel de amor*, the *Abenceraje*, the *Lazarillo*, Montemayor's *Diana*. One course. *Wardropper*

252. Spanish Lyric Poetry Before 1700. A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razon de amor*, la poesia de tipo tradicional, and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de Leon, and Herrera; on Gongora and Quevedo. One course. *Wardropper*

253. The Origins of the Spanish Theatre. A study of the evolution of the Spanish theater from the *Auto de los Reyes Magos* (twelfth century) to the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gomez Manrique, Encina, Gil Vicente, Torres, Naharro, Lope de Rueda, Juan de la Cueva. One course. *Wardropper*

255, 256. Modern and Contemporary Latin American Literature. First semester: the coming of age of Latin American poetry in the nineteenth and twentieth centuries. Second semester: trends in twentieth century Latin American fiction. Two courses. *Fein*

257. Old Spanish Language. The historical development of the language. Illustrative readings. One course. *Davis*

258. Old Spanish Literature. An introduction to medieval Spanish literary texts. One course. *Davis*

259. Spanish Phonetics. A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. Prerequisite: Spanish 176 or permission. One course. *Predmore*

261. Nineteenth-Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdos, Pardo Bazan, Blasco Ibañez, and their contemporaries. One course. *Davis*

262. Galdos. Works selected from the *Novelas contemporaneas,* the *Episodios nacionales,* and his drama. One course. *Davis*

265. Golden Age Literature: Cervantes. The life and thought of Cervantes with special emphasis on his *Quijote*. One course. *Predmore and Wardropper*

266. Golden Age Literature: The Drama. A study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. One course. *Wardropper*

275, 276. Contemporary Spanish Literature. First semester: the essay and lyric poetry. Revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: tradition and innovation in the twentieth-century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle Inclan, and Perez de Ayala. Two courses. *Predmore*

ROMANCE LANGUAGES

218. The Teaching of Romance Languages. Evaluation of objectives and methods; a study of the practical problems involved in teaching these languages on the elementary, secondary, and college level; analysis of textbooks, special foreign language programs, audiovisual aids; critical examination of modern techniques in written and oral testing. One course. *Hull*

DEPARTMENTAL MAJOR

Prerequisite. French or Spanish 64 or proficiency.

Major Requirements. Literature major: a total of eight courses (above 64), no fewer than five literature courses, and no fewer than two language courses. The literature courses must represent at least three of the six historical periods (Medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth centuries for French; and Medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth, and Spanish American for Spanish).

Language Major. A total of eight courses, no fewer than four language courses (for French, from 100, 126, 127, 150T, 209, 210, 224; for Spanish, from 100, 150T, 176, 177, 257, 259) and no fewer than two literature courses.

In order to give perspective to a student's program, majors in Romance languages will normally select, with the approval of the major adviser, appropriate courses from such fields as: (1) other languages and literature; (2) history; (3) philosophy; (4) appreciation courses in music and art; and (5) linguistics.

Russian

For courses in Russian, see *Slavic Languages and Literatures*.

Slavic Languages and Literatures

Associate Professor Krynski, *Chairman:* Assistant Professor H. Pavlov, *Director of Undergraduate Studies* and *Supervisor of Language Instruction;* Associate Professors Jezierski and M. Pavlov; Assistant Professor Shonek

1-2. Elementary Russian. Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Staff*

63-64. Intermediate Russian. Intensive classroom and laboratory practice in spoken and written patterns. Reading in contemporary literature. Prerequisite: Russian 1-2, or two years of high school Russian. Two courses. *Staff*

66. Russian Conversation. For the development of fluency in spoken Russian through the acquisition and retention of an extensive vocabulary. Discussions will deal with topics of contemporary interest. May be taken concurrently with or upon completion of Russian 64 or equivalent. One course. *Staff*

105. The Russian Theatre and Drama. Russian drama from its beginnings to the present. Readings in English or Russian. One course. *Jezierski*

119. Introduction to Russian Literature of the Nineteenth Century. Conducted in Russian. Prerequisite: Russian 63-64 or equivalent. One course. *M. Pavlov*

120. Introduction to Russian Literature of the Twentieth Century. Conducted in Russian. Prerequisite: Russian 119. One course. *M. Pavlov*

119P, 120P. Preceptorial. Elective preceptorials for students enrolled in Russian 119, 120. *M. Pavlov*

124. Masters of Russian Short Fiction. Includes Pushkin, Gogol, Tolstoy, Dostoevsky, Chekhov, and Babel. Readings in English. One course. *Jezierski*

179. Twentieth-Century Russian Prose. Modern prose in the original. Textual analysis of Russian prose since the turn of the century. Prerequisite: Russian 1-2, 63-64, or permission of instructor. One course. *Krynski*

180. Masterpieces of Russian Literature of the Nineteenth Century. Poems, plays, and prose by such authors as Pushkin, Turgenev, and Chekhov in the original. Prerequisite: permission of instructor. One course. *Krynski*

184. Soviet Writers of the 1960's. Poems, prose, and plays by Yevtushenko, Voznesensky, Sinyavsky-Tertz, Daniel-Arzhak, Solzhenitsyn, and others. Readings in English. Qualified students may do some readings in Russian. One course. *Krynski*

185. Vladimir Nabokov. The Russian and English novels, short fiction, plays, poetry, and criticism of Vladimir Nabokov. Readings in English. Qualified students may do some readings in Russian. One course. *Jezierski*

186. Non-Russian Slavic Literatures. Selected Polish, Czech, Serbian, roatian, and Bulgarian authors, from the beginnings to recent times. Readings in nglish. One course. *Jezierski*

191, 192. Independent Study. Directed reading and research. Open only o highly qualified students by permission of the department. Two courses.

193, 194. Independent Study. Directed reading and research for qualified eniors. Prerequisite: permission of the department. Two courses. *M. Pavlov and taff*

201, 202. The Novelists of Nineteenth-Century Russia. Development of he Russian novel against the European background, with emphasis on Dostoevsky nd Tolstoy. Extensive readings in English or Russian. Two courses. *Krynski*

205. The Structure of Polish in Relation to Russian. Comparative and ontrastive study of the two major Slavic languages. Emphasis on preparing stuents to read Polish literary texts. One course. *Krynski*

206. Readings in Contemporary Polish Prose in the Original. Stylistic nalysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek olakowski and short stories by Slawomir Mrozek and Marek Hlasko. One course. *rynski*

207. Soviet Literature and Culture. Literature since 1917. Readings in nglish or Russian from major works of prose, poetry, and drama. One course. *ezierski*

207P. Preceptorial. Elective preceptorial for students enrolled in Slavic anguages and Literatures 207. *Jezierski*

212S. Pushkin. A survey of his life and works, with attention given to is role as a precursor of modern Russian literature. Readings in English or Russian. rerequisite: Russian 101 or the instructor's permission. One course. *Krynski*

213. The Slavs: Literature and Culture, 1918-1939. Representative literary nasterpieces from Poland, Czechoslovakia, Yugoslavia, and Bulgaria compared nd contrasted with attention to Soviet influences. Readings in English. One ourse. *Krynski*

213P. Preceptorial. Elective preceptorial for students enrolled in Slavic anguages and Literatures 213. *Krynski*

214. The Slavs: Literature and Culture, 1940-1970. Representative literary nasterpieces from Poland, Czechoslovakia, Yugoslavia, and Bulgaria compared nd contrasted with special emphasis on cultural de-Stalinization in Eastern Europe nd in the Soviet Union. Readings in English. One course. *Krynski*

214P. Preceptorial. Elective preceptorial for students enrolled in Slavic anguages and Literatures 214. *Krynski*

215, 216. Advanced Composition and Syntax. Morphological and synatic structure of modern Russian compositions based on literary topics. Prereuisite: Russian 119, 120 or permission of instructor. Two courses. *M. Pavlov*

225S. Leo Tolstoy. Life and works. One course. *Jezierski*

227. Gogol. Life and works: short stories, dramas, and the novel. Reading in English, but students knowing Russian will do part of the reading in th language. One course. *Jezierski*

230. Chekhov and the Russian Prose of the Turn of the Century. Structural analysis of Chekhov's short stories and plays against the background o contemporary Realist, Impressionist, Symbolist, and Decadent trends in Russia prose. One course. *Krynski*

230P. Preceptorial. Elective preceptorial for students enrolled in Slavi Languages and Literatures 230. *Krynski*

232. Fyodor Dostoevsky. The major fiction of a leading nineteenth century Russian writer. One course. *Jezierski*

236S. Russian and Polish Romanticism. Prose, poetry, and drama o such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski against th background of the Romantic movement in Western Europe. One course. *Krynsk*

DEPARTMENTAL MAJOR

Prerequisites. Russian 1-2 and 63-64, or equivalent.

Major Requirements. A minimum of eight courses in the department. A majors must take the following four obligatory courses: Russian 91, 92, 215, 216 plus four courses in literature, two of which must be selected from the 200-leve courses.

Students contemplating graduate work in the Slavic field may elect a mor intensive program consisting of ten courses. A knowledge in depth of Russia literature, or some knowledge of Polish language and/or literature, will facilitat admission to graduate school and subsequent study in the field.

Sociology

Professor Kerckhoff, *Chairman*; Assistant Professor Hartford, *Director of Undergraduate Studies;* Professors Back, Maddox, McKinney, Myers, Palmore, Preiss Roy, Smith, and Tiryakian; Associate Professors Simpson and Wilson; Assistan Professors Brehm, Hirschman, House, Mason, and Schneller

Sociology 91 or special permission of the instructor or the Director of Unde graduate Studies is a prerequisite for all sociology courses at the 200-level.

To provide a variety of educational experiences for the beginning student o sociology, the introductory course, Introduction to Sociology: Concepts and Procedures, has a variety of structures. In each, however, students learn basic approaches of sociology to social reality and some of the problems involved in observing, describing, and analyzing facets of social life.

91. Sections of limited enrollment (maximum thirty-five). One course *Staff*

91D. Two lectures and one discussion section (no more than twenty student per section). One course.

91S. Taught as a seminar, limited enrollment. One course. *Staff*

91X. Taught as a seminar, limited enrollment, open to invited freshmen only. *Simpson*

132. Introduction to Sociological Research. Principles and procedures of sociological research. One course. *Mason and Preiss*

136. Sociology of Modern Africa. An introduction to the modernization of sub-Saharan Africa. Primary emphasis given to the nature and formation of colonial society, as well as to the process of decolonization and its sources. One course. *Tiryakian*

139. Comparative Social Structure. Comparison of social phenomena in two or more societies. Sociological propositions, tested with American data and data from other societies. One course. *Hirschman and Wilson*

141. Introduction to Social Demography. Relation of fertility, mortality, and migration to social development and population composition and distribution. One course. *Hartford and Myers*

142. The Sociology of Mass Communication. An analysis of the role of radio, the press, magazines, movies, and television in modern societies. An examination of the selective audiences, content characteristics, controlling elements, and organizational structure of the various media of mass communication. One course. *Smith*

143. Deviant Social Behavior. Analysis of deviant behavioral systems (illness, crime, delinquency) in terms of precipitating social factors, patterns and goals, remedial and counteracting controls. One course. *Preiss*

144. Political Sociology. Politics as social behavior involving change in nstitutions and structures; current national and local issues. One course. *House and Preiss*

145. Urban Sociology. Historical, demographic, and ecological materials are used to study urban society with respect to its institutions, interaction patterns, differentiation, integration disorganization, and decentralization. One course. *Myers and Smith*

146. Industry and Society. A study of industrial institutions in their interrelationships with other forms of social behavior in the broad cultural setting of Western civilization. Attention will center upon analysis of specific social problems resulting from the impact of industrial change. One course. *Roy*

147. The Black in the City. A comparative analysis of the situations and experiences of black people in urban settings with attention to class, caste, ethnic, social, and racial factors. One course. *Staff*

150. The American Family. The American family as an institutionalized group and its relationship with other institutions; the social psychology of family relationships; variations by social class and ethnic group. One course. *Kerckhoff and Roy*

151. Sociology of Religion. The religious factor and the social factor in religion. Major sociological theories and selected research studies. One course. *Tiryakian and Wilson*

154S. The Sociology of the Arts. An analysis of the social relations of the world of the arts (painting and sculpture, music, and literature) with emphasis upon creative artists, art publics, art organizations, and art works as they function in their social-cultural milieux. One course. *Back*

155. Introduction to Industrial Sociology. An analysis and appraisal of the various factors that affect human relations in industry. The interpersonal and intergroup relationships within the individual industrial unit which determine its efficiency as an economic and social institution and the social conditions in the community as they affect social relations. One course. *Roy*

156. The Contemporary Woman: History and Prospects. For description see Interdisciplinary Course 156.

159. Black and White Relations in America. The history and changing nature of interaction between Blacks and Whites, including the sources and consequences of discrimination, integration, and Black power. One course. *Palmore*

172. Collective Behavior. Rumor and contagion as general processes; collective expression such as riots, protests, and behavior in disaster. Focus on contemporary Western society. One course. *Kerckhoff*

173. Social Movements. Social movements as agents of change. Structure and development of protest groups. One course. *Wilson*

182. Introduction to Sociological Theory. Images and theories developed to understand social behavior; a survey of current issues. One course. *Wilson*

185, 186. Junior Tutorial. Prerequisites: Sociology 91 (or 91D or 91S) and permission of the Director of Undergraduate Studies. Half-course each semester course. *Staff*

195S, 196S, 197S, 198S. Senior Seminar in Special Topics. Four courses. *Staff*

225. Medical Sociology. One course. *Maddox*

241. Social Stratification. The nature of hierarchical and vertical differentiation for the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. One course. *Mason and Roy*

242. The Sociology of Occupations and Professions. The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, and the social organization of occupational groups. One course. *Roy and Simpson*

243. Population Dynamics and Social Change. Social scientific aspects of the determinants and consequences of population trends both national and international. One course. *Hartford and Myers*

251. The Sociology of Modernization. Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries One course. *Hirschman and Tiryakian*

253. Social Institutions. The study of particular institutions and the social movements out of which they developed, with emphasis on the development of general propositions concerning the nature, function, and importance of institutions in society. One course. *Staff*

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. One course. *Hirschman*

259. Religion and Social Change. The role of religion in significant social changes in Western and non-Western societies; non-institutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). Prerequisite: either Anthropology 264, Sociology 151, or the equivalent. One course. *Tiryakian and Wilson*

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, caste, urban-rural); contributions made by various socialization agencies (family, school, peer groups, mass media) in Western society. One course. *Kerckhoff*

275. Social Attitudes and Individual Behavior. Such issues as the following are considered: the importance of symbolic interaction, the development of the "Self," the social structuring of the socialization process, individual movement within the social structure, and the importance of membership groups and reference groups. One course. *Back and Kerckhoff*

287S. Social Structure and the Life Cycle. A study of the relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. One course. *Maddox*

295. Methodology in Sociology. Considerations of the nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation both on the general level of research design and the specific level of special techniques. The process and logic of data analysis. Relations of theory and research are stressed. One course. *Mason and Smith*

297. Statistical Analysis in Sociology. Such techniques as zero and higher order linear and curvilinear correlation, partial correlation, analysis of variance and covariance and factorial design are studied. When possible, analogous nonparametric techniques are also considered. Prerequisite: permission of the instructor. One course. *Brehm*

298S, 299S. Seminar in Selected Topics. Selected substantative, theoretical, or methodological topics. Two courses. *Staff*

DEPARTMENTAL MAJOR

Prerequisite. Sociology 91.

Major Requirements. Seven courses in the department above 91, including Sociology 132 and either one 200-level course or one senior seminar.

A sociology major normally takes at least four related courses in one of the following departments: Anthropology, Economics, Education, History, Mathematics, Political Science, or Psychology.

Spanish

Four courses in Spanish, see *Romance Languages.*

Statistics

Statistics courses which are offered in several departments at Duke are classified according to function (Tracks) and level as follows: Track 1 includes statistical inference courses for non-statisticians; Track 2, statistical inference courses for statisticians; Track 3, stochastic processes courses; and Track 4, stochastic communications theory courses. Within each track, courses are classified by level according to the amount of prerequisite statistical knowledge needed. First-leve Track 1 courses, which are basic statistics courses for non-statisticians, cover a certain core curriculum and have no formal statistical prerequisites. For further information on the statistics courses at Duke, see mimeographed material, *Statistics at Duke,* which is available on request from the Department of Mathematics.

University Courses

University courses are offered by senior named professors, as electives for juniors and seniors, in a form free from ordinary class restrictives.

199.1. Comparative Politics: Western Europe. One course. *Cole*

Zoology

Professor Fluke, *Chairman;* Associate Professor Ward, *Director of Undergraduate Studies;* Professors Bailey, Bookhout, Buettner-Janusch, Costlow, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, and K. Wilbur; Associate Professors Barber, Gillham, Tucker, Vogel, and Wainwright; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Bernstein, Forward, Lundberg, McClay, Sutherland, and H. Wilbur; Instructor Baudinette

See *Biology* for listing of introductory courses.

In addition to those courses bearing the *S* suffix, the following Zoology courses also fulfill the seminar-type learning experience: 103L, 120L, 180L, 186L, 201L, 216L, 224L, 238L, 242L, 245L, 258L, 286L.

95S, 96S. Undergraduate Seminars. One course maximum except with permission of the Director of Undergraduate Studies. *Staff*

103L. Principles of Ecology. An introduction to the study of organisms in natural habitats, with particular attention to the growth of animal populations, the chemical role of organisms, energy flow through food chains, and the development of ecological systems through geologic time. Prerequisites: college biology and Mathematics 31. Lectures and laboratories. One course. *Livingstone and H. Wilbur*

108L. Developmental and Comparative Anatomy of Vertebrates. Lectures and laboratory on the embryology, anatomy, and evolution of vertebrate organ systems. Not open to students who have had Zoology 53 or 56. Prerequisite: college biology. One course. *Lundberg*

117. Heredity and Society. An introduction to genetics, with emphasis on the effects of environment and heredity upon the individual and population. A student may not receive credit for both Zoology 117 and 71 or 180. Prerequisite: college biology or consent of the instructor. One course. *Ward*

120L. Ornithology. Lectures, laboratory, and field trips dealing with the lassification, adaptations, and natural history of birds. Prerequisite: college iology; Zoology 108 is recommended. One course. *Bailey*

131. Human Evolution I. Evolutionary biology of the primates. Anatomical, ehavioral, and molecular adaptations of fossil and living primate populations in- luding *Homo sapiens.* Prerequisite: college biology; or consent of instructors. Also listed as Anatomy 231 and Anthropology 231.) One course. *Buettner- anusch and Cartmill (Anatomy)*

131D. Human Evolution I. Same as 131 with discussion period included. ne course. *Buettner-Janusch and Cartmill (Anatomy)*

132. Human Evolution II. Human population and biochemical genetics. nalysis of the effects of natural selection on past and present human populations. rerequisite: Zoology 131 (Anatomy 231, Anthropology 231) or consent of in- tructor, or a course in genetics. (Also listed as Anatomy 232 and Anthropology 32.) One course. *Buettner-Janusch*

132D. Human Evolution II. Same as 132 with discussion period included. ne course. *Buettner-Janusch*

150L. Physiology of Marine Organisms. Comparative studies including pecial ecological and behavioral adaptations. Lectures and laboratories. A student nay not receive credit for both Zoology 150L and 250L. Prerequisites: college iology and chemistry; consent of instructor and director of undergraduate studies f student's major department. (Given at Beaufort.) One course. *Forward*

151. Principles of Physiology. An introductory survey. Prerequisites: ollege biology and a year of chemistry. One course. *Tucker*

151L. Principles of Physiology. Same as 151 with laboratory included. ne course. *Tucker*

160. Principles of Cell Biology. Structure and function of organelles, etabolism, and regulatory mechanisms. Prerequisites: college biology and chemis- y. One course. *McClay*

160L. Principles of Cell Biology. Same as 160 with laboratory included. ne Course. *McClay*

169L. The Marine Environment. For description see Marine Sciences.

171S. Marine Sciences Seminar. For description see Marine Sciences.

174L. Animal Diversity. Form and function. Not open to students who have ad 275. Lectures and laboratories. Prerequisite: college biology. One course. *Vainwright*

175L. Invertebrate Zoology. Lectures, readings, and laboratory dealing vith free-living and parasitic invertebrates. Field trips to freshwater and marine abitats. Not open to students who have had 174 or 274. Prerequisite: college iology. (Also listed as Zoology 275L.) One course. *Bookhout*

180. Principles of Genetics. Structure and properties of genes and chromo- omes, and evolution of genetic systems. (Also listed as Botany 180, Botany 280, nd Zoology 280.) Prerequisites: introductory courses in biology, chemistry, and nathematics, or equivalent. One course. *Boynton (Botany), Gillham, and Others f the University Program in Genetics*

180L. Principles of Genetics. Same as 180 with laboratory include One course. *Boynton (Botany), Gillham, and Others of the University Progra in Genetics*

186. Evolution. Processes of adaptation and evolution in individuals, pop lations, and genetic systems. (Also listed as Botany 186, Botany 286, Zoology 28 and under the University Program in Genetics.) Not open to students who have ha Zoology 109 or Botany 240. Prerequisite: genetics or consent of the instructo One course. *Antonovics (Botany) and Lundberg*

186. Evolution. Same as 186 with laboratory included. One cours *Antonovics (Botany) and Lundberg*

191T, 192T. Independent Study. For senior and junior majors with pe mission of the Director of Undergraduate Studies and the supervising instructo Three courses maximum. *Staff*

195S, 196S. Undergraduate Seminars. Two courses maximum exce with permission of the Director of Undergraduate Studies. *Staff*

197S, 198S. Undergraduate Seminars. Do not satisfy major or distributional requirements. One course maximum except with permission of the Directo of Undergraduate Studies.

201S. Animal Behavior. Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or consent o instructor. One course. *Klopfer*

201L. Animal Behavior. Same course as 201 except laboratory include One course. *Klopfer*

202L. Introduction to Comparative Behavior. Behavior as revealed b physiological, evolutionary, and ecological studies with primary emphasis on marin groups. Lecture and laboratory. Prerequisite: one course in physiology. (Given a Beaufort.) Two courses. *Salmon*

203L. Marine Ecology. Class discussion on selected papers, and field projects; practice in scientific writing and use of computers in ecology. Prerequisites a course in general zoology, invertebrate zoology, or an appropriate equivalent and a year of mathematics; some knowledge of statistics will be helpful. (Give at Beaufort.) Two courses. *Sutherland*

204L. Population and Community Ecology. Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interactin species, and mechanisms of species interactions. Laboratories emphasize biometrica and experimental testing of ecological theory in relation to a variety of habitats Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus senior or graduate standing, or permission of instructor. One course. *H. Wilbu*

205. Elements of Theoretical Biology. An introduction to elementar mathematical biology, conceived as the study of axiomatized mathematical theorie and their biological models. Prerequisites: college biology and mathematics, o consent of instructor. One course. *Gregg*

212L. Marine Membrane Physiology. Physiology of marine and estuarin organisms, with emphasis on cellular transport and electrophysiological processes Include laboratory work on functions, mechanisms, and comparative aspects o onic and osmotic regulation in marine plants and animals. Prerequisite: permission f instructor. (Also listed as Physiology 212.) Given at Beaufort. Two courses. *utknecht, Schoffeniels, Wachtel, and Staff* (*Physiology*)

213. Ecological Oceanography. Population ecology and energy relationhips of life in the open ocean. Lectures, seminars, and some sea-time. Prerequisites: ourses in ecology or invertebrate zoology, chemistry, and calculus; differential quations is strongly recommended. One course. *Staff*

214L. Biological Oceanography. Composition in time and space of maine biosphere in relation to descriptive marine chemistry, physics, and geology. ome work at sea aboard the research vessel. Prerequisites: a course in inverterate zoology, ecology, marine biology or an appropriate equivalent, chemistry hrough organic, and one year of physics and mathematics. (Given at Beaufort.) wo courses. *Barber*

216L. Limnology. Lakes, ponds, and streams; their origin, development, eochemistry, energy balance, productivity, and the dynamics of plant and animal ommunities living in them. Lectures, field trips, and laboratory work. Usually ffered in alternate years. Prerequisites: college biology, chemistry, physics, and athematics 31, or permission of instructor. One course. *Livingstone*

224L. Vertebrate Zoology. Life histories, adaptations, ecology, and clasification of vertebrate animals. Lectures and laboratories. Prerequisite: Zoology 08. One course. *Bailey*

229. Morphogenetic Systems. Lectures on the interplay of theory and exeriment in twentieth century developmental biology. Prerequisite: college biology. ne course. *Gregg*

229L. Morphogenetic Systems. Same course as 229 except laboratory ncluded. One course. *Gregg*

236. Human Genetics. Emphasis upon the uniqueness of studies in human, linical, biochemical, and population genetics. (Listed also as Anatomy 236, Anhropology 236 and under the Genetics Program.) Prerequisite: Zoology 131 Anatomy 231, Anthropology 231) or an introductory course in college biology ncluding genetics, or permission of the instructor. One course. *Buettner-Janusch*

236D. Human Genetics. Same as 236 with discussion period included. One ourse. *Buettner-Janusch*

238L. Systematic Zoology. Theory and practice of collection, identification, nd classification of animals. Lectures and laboratories. Prerequisite: college iology. One course. *Bailey*

239S. Biogeography. Old and new distributional concepts of animals and lants involving physical geography, geology, paleontology, systematics, evolution, opulation dynamics, and dispersal. Prerequisites: permission of the instructor. ne course. *Bailey*

240L. Chemical Oceanography. Physicochemical properties of seawater. ectures, laboratory work, and field trips. Prerequisite: a year of analytical or hysical chemistry, an introductory course in general or physical oceanography or ermission of the instructor. (Also listed as Chemistry 240.) (Given at Beaufort.) wo courses. *Baier* (*Chemistry*)

245. Radiation Biology. Actions of ionizing and excitational radiation on life processes; biological use of radioactive tracers; nucleonics. Prerequisites college physics, mathematics, and chemistry. One course. *Fluke*

245L. Radiation Biology. Same course as 245 with laboratory included One course. *Fluke*

246S. Physical Biology. Physical principles of structure and function i large biological molecules and aggregates; applications to function at higher level of organization, and to biological fitness. Prerequisites: college mathematics, chemistry, physics, and one biology course beyond the introductory course, or consen of instructors. One course. *Fluke and Wainwright*

248. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, nucleic acids, and the metabolic interrelationships of these compounds. Th biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction and muscle contraction will also be considered. Prerequisites: organic chemistr (second semester may be concurrent) and college mathematics, or permission o instructor; Chemistry 61 or 101 is recommended. One course. (Also listed a Biochemistry 247 and Botany 248.) *Webster (Biochemistry) and Sage (Biochemistry)*

250L. Physiological Ecology of Marine Animals. The physiological responses of marine animals to certain environmental factors and evolution. Lecture and laboratories. Prerequisite: a course in physiology. (Given at Beaufort.) Tw courses. *Forward*

252. Comparative Physiology. The physiological mechanisms of animal studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. On course. *Schmidt-Nielsen*

254S. Fluid Flow and Living Systems. Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: college physics and Mathematics 31 or equivalent One course. *Vogel*

258L. Laboratory Research Methods. Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy X-ray diffraction, gel electrophoresis, isolation of cell components, and othe methods. Students may select methods according to their interests and research needs. Prerequisite: consent of the instructor. Credits to be arranged. *K. Wilbu and Staff*

260. Advanced Cell Biology. Structural and functional organization o cells and their components, emphasizing current research problems and prospects Prerequisites: introductory cell biology or genetics and permission of instructor One course. *Nicklas, K. Wilbur, and Staff*

262L. Cytological Materials and Methods. General cytological analysis with emphasis on chromosome studies using current optical, cytochemical, and other experimental techniques. Prerequisite: Zoology 160 or 260 or equivalen (may be taken concurrently). Half-course. *Nicklas*

266S. Topics in Cell Structure and Function. Advanced discussion o selected problems such as chromosome structure, mitosis, and cytological aspects of inheritance and development. Prerequisites: Zoology 160 or 260 or equivalen and permission of the instructor. (Alternates with Zoology 288.) (Also listed as Anatomy 266.) Half-course. *Nicklas and Moses (Anatomy)*

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips included. Not open to students who have had 275. Prerequisite: college biology. (Given at Beaufort.) Two courses. *Staff*

275L. Invertebrate Zoology. Lectures, readings, and laboratory work dealing with free-living parasitic invertebrates. Field trips to freshwater and marine habitats. Not open to students who have had Zoology 174 or 274. Prerequisite: college biology. (Also listed as Zoology 175L.) One course. *Bookhout*

276L. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Prerequisite: consent of the instructor. (Also listed as Biochemistry 276.) (Given at Beaufort.) Two courses. *Sullivan (Biochemistry)*

277L. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals; primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) Two courses. *Hagadorn*

278L. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) Two courses. *Bookhout*

280. Principles of Genetics. Structure and properties of genes and chromosomes and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics, or equivalent. (Also listed as Botany 180, Botany 280, and Zoology 180.) One course. *Boynton (Botany), Gillham, and Others of the University Program in Genetics*

286. Evolution. Processes of adaptation and evolution in individuals, populations, and genetics systems. (Also listed as Botany 186, Zoology 186 and under the University Program in Genetics). Not open to students who have had Zoology 109 or Botany 240. Prerequisite: genetics or consent of the instructor. One course. *Antonovics (Botany) and Lundberg*

286L. Evolution. Same as 286 with laboratory included. One course. *Antonovics (Botany) and Lundberg*

288S. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. (Alternates with Zoology 266.) Prerequisites: a course in genetics and permission of one instructor. (Also listed as Anatomy 288.) Half-course. *Counce (Anatomy), Gillham, and Staff*

295S, 296S. Seminar. Topics, instructors, and course credits announced each semester. *Staff*

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of The University Program in Genetics; see announcement in this *Bulletin*.

Marine Laboratory. The following courses are given at Duke University Marine Laboratory, Beaufort, N. C.: 150, Physiology of Marine Organisms; 169, The Marine Environment; 171, Marine Sciences Seminar; 202, Introduction to Comparative Behavior; 203, Marine Ecology; 214, Biological Oceanography; 240, Chemical Oceanography; 250, Physiological Ecology of Marine Animals; 274, Marine Invertebrate Zoology; 276, Comparative and Evolutionary Biochemistry; 277, Endocrinology of Marine Animals; 278, Invertebrate Embryology. Consult Marine Sciences in this *Bulletin* for other offerings at the Duke University Marine Laboratory and for details of the spring semester program for undergraduates at Beaufort.

DEPARTMENTAL MAJOR

Prerequisites. Biology 11-12 or Biology 14 or consent of the Director of Undergraduate Studies.

Major Requirements. A minimum of eight courses, not including the above prerequisites. Of the eight courses, at least four must be zoology courses other than independent study and seminars, two of which must have related laboratory experience. Three of the remaining four courses ordinarily consist of courses in chemistry beyond organic chemistry or courses in other related departments beyond the introductory level. Acceptance of such courses for inclusion in the basic eight requires prior permission of the Director of Undergraduate Studies with the exception of Chemistry 160 and any mathematics course beyond Mathematics 31 and 32. (Members of classes entering prior to 1972 may be graduated under these regulations if they wish.)

Areas of Concentration. Molecular and Cellular Biology (Cell Physiology, Cytology, Genetics, Development); Organismic Biology (Comparative Physiology, Comparative and Functional Morphology, Embryology); Population Biology (Population Genetics, Speciation, Systematics, Biogeography); Animal Behavior; Ecology (including Biological Oceanography and Limnology).

Departmental Handbook for Majors. Any student who is interested should obtain a copy of the *Handbook for Zoology Majors* from the office of the Director of Undergraduate Studies. The *Handbook* suggests appropriate combinations of courses for the above listed areas of biological study, describes the advising system and special programs, and gives the interests and background of the faculty.

B.A. and B.S. Degrees. No distinction is made between the B.A. and B.S. degree; you may receive either degree by indicating your choice at the time of declaration of your major.

School of Nursing

Professor Wilson, *Dean;* Assistant Professor Brundage, *Acting Director of Undergraduate Studies;* Professors Fortune, Gratz, Jacobansky, Minniear, Stone, and Whitner; Associate Professors Bowers, Hall, Horton, Norville, Reckless, and Schenk; Assistant Professors Bourbous, Breedlove, Bullock, Davenport, Dery, Dietz, Gelein, Ingram, Lamper, Long, Montgomery, Persing, Pounds, Turner, and Young; Instructors Askins, Bowling, Hesse, Humphrey, Mandetta, O'Brien, Wagner, and Woods; Lecturer Harris

97, 98. Human Ecology I and II. An interdisciplinary course in the natural sciences covering the impact of a changing physical and biological environment upon man. Open to non-nursing majors. Two courses. *Gratz*

101-102. Theoretic and Scientific Bases of Nursing Practice. Builds upon courses in human ecology to explore major theories of man's normal adaptive responses and his responses to threats to his health. Multicausal factors and gradients of disease are considered from the framework of major assaults to man's integrity: excesses and deprivation, infection, trauma, endocrine imbalance, malformations, and neoplasms. Two courses. *Staff*

103-104. Development of Nursing Skills and Attitudes. Correlated with Nursing 101-102 by selection of patients as exemplars of man responding to assaults. Students will be giving nursing care to these patients of all ages in a variety of settings. Likenesses and differences will be shared in weekly seminar. Nursing practice will encompass the development of psychomotor skills essential to the process of nursing. Four courses. *Staff*

121S. Parenthood. An investigation of parenting behavior with a focus on the meaning of experiences to the mother and father and the means by which individuals can maximize the positive potential of these experiences. Open to non-nursing majors. One course. Pass/Fail option. *Harris*

151. Functional Aspects of Nursing Practice. Theories, practices, and constraints influencing functional roles in nursing practice, e.g., economics and systems of health care, organization, and administration of agencies and institutions delivering health care, legal protection, and constraints of the practitioner. One course. *Staff*

153, 154. Distributive and Episodic Nursing Practice. Continuation of Nursing 101-102, and Nursing 103-104 into the senior year. Each student will have learning experiences with patients in each of the major clinical areas: medical, surgical, psychiatric, maternal and child health, and community health nursing. In Distributive Nursing Practice, the family life cycle is the focus for acquiring the conceptual, interpersonal, and technical skills for the assessment, promotion and maintenance of health of families and other groups. Community facilities and ambulatory health services are the locales for nursing practice. The focus of Episodic Nursing Practice is the direct care of hospitalized patients with complex, acute or chronic, mental and physical illness wherein rapid and/or crucial nursing decisions are required and collaboration with other health disciplines is essential. Four courses. *Staff*

161. Applied Human Physiology. An in-depth study of selected physiological processes significant to the health needs of man. Emphasis is upon those aspects of physiology that are reflected in patient care problems requiring effective nursing intervention. Open to non-nursing majors. One course. Pass/Fail option. Fall only. *Gratz*

162. Ecological Concepts and Their Application to Environmental Health. An in-depth study of current environmental problems significant to the health needs of man. Emphasis is on those ecological concepts that are reflected in patient health problems. Open to non-nursing majors. One course. Pass/Fail option. Spring only. *Gratz*

163S. Suicidology and Crisis Intervention. Exploration of theories related to destructive behavior, and methods for intervening and managing individuals and families before, during, or following such periods. Clinical practice will be provided for applying theories and techniques. Open to non-nursing majors with the permission of the instructor. One course. Pass/Fail option. *Breedlove*

167S. Poverty and Health. A study of poverty designed to develop an awareness of the relationship between poverty and health. Seminars, films, and actual experience with poverty groups will be used to acquaint the student with a diversity of perceptions and observations germane to an understanding of health problems among the poor. Open to non-nursing majors with the permission of the instructor. One course. Pass/Fail option. *Long*

169. Human Sexuality. A study of the intrapersonal, interpersonal, and sexual aspects of an individual's existence and the forces shaping prevailing and future sexual expressions and human sexuality. Open to non-nursing majors. One course. Pass/Fail option. *Reckless*

172. Psychosomatic Illness and Group Process. A study of patients with psychosomatic and somatopsychic illness with opportunities to explore causal factors together with approaches for alleviation. Nursing and medical students assume responsibility for direct patient care under supervision and have the opportunity to attend group therapy sessions. Permission of the instructor. Pass/Fail option. One course. *Reckless*

178. Advanced Concepts of Nursing for Patients with Cardiovascular Disease. Examination and clinical exploration of the role of the nurse in providing health care to individuals with cardiovascular disease. Open to senior nursing students. One course. Pass/Fail option. *Dery and Gelein*

179. Nursing in Nephrology. Planned experience providing nursing care for patients with clinical disturbances of renal function and hypertension utilizing current treatment modalities in a variety of treatment settings. Open to second semester juniors and seniors in the nursing major. One course. Pass/Fail option. *Brundage*

183. Introduction to Methods of Research in Nursing. Study of the research process in nursing; emphasis on critiques of published research reports with implications for nursing practice. Prerequisites: basic statistics and Nursing 103 or permission of the instructor. One course. Pass/Fail option. *Whitner*

187. Patient Evaluation. A study of the historical development of disease process through methods and techniques of eliciting health history and physical examination. The relationship of historical and physical data is demonstrated by experience with in-hospital patients. Open to second semester juniors and seniors in the nursing major. One course. Pass/Fail option. *Wilson*

189. Psychiatric Nursing. Focuses on dynamic psychiatric nursing and provides opportunities for the student to increase depth of knowledge of and skill in applying concepts of psychiatric nursing intervention in selected settings. Open to seniors in the nursing major. One course. Pass/Fail option. *Bullock*

191, 192, 193, or 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/Fail option. *Staff*

MAJOR IN NURSING

The major requirements are included in the minimum total of 32 courses listed under Lower and Upper Division Requirements on page 31. The specific courses in the upper division satisfying the nursing major that must be included are: Nursing 101, 102, 103, 104, 151, 153, 154, and 191, 192, 193, or 194.

School of Engineering

ENGINEERING (INTERDEPARTMENTAL)

11. Introductory and Computer Graphics. Elements of engineering graphics as a means of visualizing and communicating engineering projects. Sketching and drawing techniques to help the engineer illustrate and convey his ideas. Graphical solution of algebraic and calculus problems. Alignment charts and nomograms. Not open to seniors. Half-course. *Arges*

21. Survey of Engineering. A course designed to assist the beginning engineering student in obtaining a general view of the profession of engineering, from first college course to ultimate practice of engineering; in gaining a better understanding of the role of the engineer in society; and in relating the various aspects of his academic program to his educational-vocational goals. Two class meetings per week. Half-course. *Meier*

31. Computers in Engineering. Introduction to use of digital computers in engineering. Attributes of digital computer systems; program languages, flow charts; numerical analysis, including approximation and interpolation, searches and maximization, linear equations; applications to engineering; introduction to decision processes in engineering, including linear programming, optimization network methods; punched card operation; graphical output. Not open to students who have completed Engineering 32, CPS 51, or ME 31. One course. *Clough and Utku*

32. Computers in Engineering. Introduction to use of digital computers. Computer systems; algorithms, flow charts; programming, Fortran IV language, Applications to curve fitting, numerical integration, analysis of force systems and their equilibrium, and solution of linear equations. Not open to students who have completed Engineering 31, CPS 51, or ME 31. Half-course. *Clough and Utku*

72. Introduction to Systems Dynamics. Unified treatment of mechanical, electrical, fluid, and thermal dynamic systems. Formulation and solution of differential equations; operators, transfer functions, and complex variables. Energy concepts for multiport system analysis. Simulation and analog solution of a variety of engineering problems. Prerequisites: Physics 51 and Math 32. One course. *Wright, Garg, and Macduff*

75. Mechanics of Solids. Analysis of force systems and their equilibrium as applied to engineering systems. Stresses and strains in deformable bodies; mechanical behavior of materials; applications of principles to static problems of beams, torsion members, and columns. Selected laboratory work. Not open to students who have completed CE 23 (see CE 73). Prerequisites: Physics 51 and Math 32. One course. *Arges, Palmer, and J. F. Wilson*

83. Structure and Properties of Solids. An introduction to materials science and engineering, emphasizing the relationships between the structure of a solid and its properties. The atomic and molecular origins of electrical, mechanical, and chemical behavior are treated in some detail for metals, alloys, polymers, ceramics, glasses, and composite materials. Prerequisites: Chemistry 11 and Math 31. One course. *Shepard, Cocks, and Pearsall*

104. Heat Transfer and Thermodynamics. Fundamentals of heat transfer multidimensional and unsteady conduction, convection, radiation, combined modes internal heat generation. Introduction to classical thermodynamics; first and second laws, properties, compressible flow, psychrometrics. Prerequisites: Physics 52 and Math 74. One course. *Elsevier and Kenyon*

122. Transport Phenomena. A unified treatment of momentum, energy and mass transport from the continuum viewpoint, emphasizing the formulation and solution of engineering problems. Conservation laws, constitutive equations, their combinations, and methods of problem solution. Prerequisite: Math 74. One course. *Chaddock and Harman*

123. Dynamics. An introduction to the principles of particle and rigid body dynamics, with engineering applications. Vector analysis used to describe the kinematics of motion in space and in a plane; the inertia tensor. Concepts of impulse-momentum and work-energy. An introduction to vibrations, wave motion, and Lagrange's equation. Prerequisites: Math 74 and Physics 51. One course. *Dvorak and J. F. Wilson*

145. Fluid Mechanics. Physical properties of fluids; fluid-flow concepts and basic equations; continuity, energy and momentum principles; dimensional analysis and dynamic similitude; viscous effects; applications, emphasizing real fluids. Selected laboratory work. Corequisite: Engineering 123 or ME 123. One course. *Muga and J. F. Wilson*

161, 162. Interdisciplinary Resources for Community Problem-Solving. The objectives of this course are to assist the student in an understanding of the self, the interaction of the self with others and the environment, and in the analysis of information useful for decision-making. Problems in the community are used as a vehicle for developing group and individual approaches to the resolution of specific problems of interest to the students in the course. Prerequisite: permission of instructor. Two courses. *Artley*

169. Legal Aspects of Engineering. A course designed to introduce engineering students to those aspects of the law encountered in the practice of engineering. Subjects included are: contracts and specifications, real and personal property, torts, insurance, agency, equity, evidence, labor management, sales, expert testimony, engineering registration, and ethics. Open to seniors only. One course. *Olive*

170. Proprietary Law for Engineers. Patents, trademarks, copyrights, trade secrets, and other forms of intellectual property are reviewed as individual and interrelated subjects. Representative law cases are assigned and discussed particularly as they affect engineering practice. Patent procedure is reviewed in some detail. Open to seniors only. One course. *Olive*

171. Systems Engineering: Deterministic Models. Fundamentals of economic decision-making for alternative engineering designs. Mathematics of cost comparisons. Selection of optimal engineering systems with time dependent costs and benefits. Principles of optimization. Linear and dynamic programming. Network analysis and critical path scheduling. Applications from decision processes in engineering and planning with particular emphasis on public works systems. Prerequisite: Math 32. Fall semester. One course. *Dajani*

172. Systems Engineering: Probabilistic Models. The purpose of this course is to provide an adequate foundation for application of probabilistic models to a variety of systems engineering problems. Emphasis is on the fundamental principles underlying various probabilistic models. Subjects considered are elementary concepts of probability theory and an introduction to decision-making under uncertainty with emphasis on the Bayesian approach to statistical decision theory. Problems selected from several areas of application. Prerequisite: Math 32. Spring semester. One course. *Kerr and Nolte*

173. Advanced Mechanics. Mechanical behavior of elastic, elastic-plastic, viscoelastic, and viscoplastic materials. Analysis of stresses and strains in simple structural elements, such as bars, shafts, beams, shells, and pressure vessels made of time-dependent and time-independent materials. Static and dynamic loading. Mechanical properties of solids under high rates of strain. Introduction to fracture mechanics. Brittle and ductile fracture, fatigue. Prerequisites: Engineering 83 and 75 or CE 73. One course. *Dvorak*

183, 184. Projects in Engineering. Courses in which engineering projects of an interdisciplinary nature are undertaken. The projects must have engineering relevance in the sense of undertaking to meet human need through a disciplined approach under the guidance of a member of the engineering faculty. Prerequisite: approval of instructor. Two courses. *Engineering Faculty*

BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman;* Associate Professor Clark, *Director of Undergraduate Studies;* Professors Bennett, Nolte, Thurstone, and Wolbarsht; Visiting Professor Cadzow; Associate Professors Barr, Hammond, and Wachtel; Adjunct Associate Professor Hills; Visiting Associate Professor Roberts

Biomedical engineering includes the application of concepts and methods in the physical, mathematical, and engineering sciences to biology and medicine. This definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the undergraduate program in biomedical engineering is to permit students who plan to dedicate their professional careers to the biomedical area to prepare themselves adequately for graduate work in biomedical engineering, medicine, or biology. This program is flexible and can satisfy the requirements for entrance either to graduate work in engineering, physiology, biology, or to medical school.

Opportunities for student research are available in the following biomedical engineering laboratories: The Cardio-Respiratory Systems Laboratory includes a PDP-12 digital computer, a PAR signal averager, and an analog computer. Computer science techniques are utilized in acquiring, processing, and modeling biological data. Research in the Biomedical Materials Laboratory is directed toward the development of materials suitable for use in biological environments such as the vascular system; Biomedical Engineering in Pediatric Cardiology measures electrical activity of the heart in animals and humans, to increase the basic knowledge of the heart itself. The Optics and Acoustics Laboratories are employed for research and instruction in the biomedical application of these fundamental areas. Ultrasound instrumentation measures and images biological tissue structures. The Neural Networks Laboratory explores the communication of information between individual nerve cells in prototypical brains. Optical, mechanical, and electronic equipment is used in recording neural activity, and computational equipment is employed for data analysis and simulation.

112. Biological Systems Analysis. Theory of physical system modeling by differential equations with major emphasis on linear dynamic analysis. Selected biomedical applications. Prerequisite: Engineering 72 or EE 63. One course. *Pilkington*

163, 164. Biomedical Electronics and Measurements. A study of the basic principles of biomedical electronics and measurements with emphasis on the operational performance and selection of transducers, instruments, and systems for biomedical data acquisition and processing. Selected laboratory work emphasizes the measurement of specific physiological events. Prerequisite: BME 112 or equivalent. Two courses. *Thurstone and Hammond*

172. Biomedical Transfer Processes. An introduction to unit operations and life systems with particular emphasis on biological interactions of artificial materials and prostheses, environmental studies, and hyperbaric exposure. Prerequisite: Engineering 122. One course. *Clark*

181. Biomedical Modeling. Introduction to biomedical modeling with particular emphasis on neural and cardiorespiratory systems exhibiting phenomena varying from cellular to the whole organism level. Prerequisite: BME 164. One course. *Wachtel*

191-192. Projects in Biomedical Engineering. This course is available to seniors who express a desire for such work and who have shown aptitude for research in one area of biomedical engineering. Half-course to two courses. *Staff*

201. Introductory Biomedical Engineering I. Fundamentals of biomedical modeling with particular emphasis on neural and cardiorespiratory systems exhibiting phenomena varying from cellular to the whole organism level. Not open to students who have had BME 181. One course. *Wachtel*

202. Introductory Biomedical Engineering II. An introduction to biomedical transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of artificial organs and prostheses. Not open to students who have had BME 172. One course. *Clark and Hills*

223. Biomedical Materials and Artificial Organs. The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. One course. *Clark*

265. Advanced Topics in Biomedical Engineering. Opportunity for study of advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Prerequisite: approval of the chairman and the instructor under whom work will be done. One course. *Staff*

Departmental Major in Biomedical Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. The specific courses BME 112, 163, 164, 172, and 181 must be included.

CIVIL ENGINEERING

Professor Vesic, *Chairman;* Professor Brown, *Director of Undergraduate Studies;* Professor Utku; Associate Professors Dvorak, Muga, Palmer, and Wilson; Assistant Professors Arges, Clough, Dajani, and Vesilind; Adjunct Assistant Professors Coffin and Drye; Instructors Hayward and Tsui

Civil engineering may be defined as the art of conception, design, analysis, and building of constructed facilities. However, the modern civil engineer may find himself engaged in such complex problems as trafficability of planetary surfaces, environmental planning for a community, or optimization of an urban transportation system. There are seven major speciality areas of civil engineering at Duke. Environmental engineering deals with the quality of human environment as affected by water supply and wastewater treatment and disposal. Geotechnical engineering is concerned with interaction between engineering structures and the earth's crust as well as with structures constructed of earth as a material. Mechanics and materials engineering is the study of the behavior of materials under various conditions of loading and environment. Ocean engineering deals with the development and use of water and marine resources. Structural engineering is concerned with economical and safe design of engineering structures. Urban engineering encompasses a broad spectrum of integrated technological problems such as land and city planning and development, mass transportation, and public health and safety. Water resources engineering is concerned with the usage, preservation, and replenishment of water resources. In addition, a student may elect a general program of civil engineering studies, or an interdisciplinary program of management sciences combined with civil engineering.

The civil engineering program at Duke is supported by the following laboratories for instruction and research. The Structural Engineering Laboratory has universal testing machines with capacities to 400,000 pounds; hardness testers; machines for testing torsion, fatigue, and impact. The department has facilities for the construction and testing of structural models, including medium-speed electronic equipment for the measurement and recording of strains and displacements. The Soil Mechanics Laboratory includes modern testing equipment and instruments, such as static and dynamic model testing accessories, as well as a triaxial shear apparatus, designed for testing soil and rock at confining pressures up to 100,000 pounds per square inch. The Fluid Mechanics Laboratory equipment includes a water wave flume with paddle-type variable frequency, constant amplitude, wave generator; and a variety of sensors. The Sanitary Engineering Laboratory is equipped for determining the characterization of waters and wastewaters and for applying biological, chemical, and physical treatment methods to improve their quality. The Materials Laboratory deals with the physical properties and stress-deformation characteristics of bituminous mixtures and concretes. The department has a representative collection of modern surveying equipment.

16. Surveying for Engineers. The theory and application of measurements required for planning, design, and construction of engineered facilities. Transit-tape and stadia surveys; differential and profile leveling; traverse computations. Laboratory included. Not open to seniors. Corequisite: Math 31. Half-course. *Arges*

23. Statics. Analysis of force systems and their equilibrium as applied to engineering systems; algebraic and graphic methods used with vector notation where appropriate. Corequisite: Math 32. One course. *Staff*

73. Mechanics of Deformable Bodies. Stresses and strains in deformable bodies; mechanical behavior of materials and relation of stress to strain; applications of principles to static problems of beams, torsion members, and columns. Selected laboratory work. Prerequisite: CE 23. One course. *Arges*

116. Transportation Engineering. The role and history of transportation. Introduction to the planning and design of links, vehicles, and terminals of all transport modes. Basic characteristics of transportation technologies. Traffic operation and control. The transportation production function. Network structure. Economic evaluation and decision-making techniques. Prerequisite: junior or senior standing; consent of instructor for nonengineering students. One course. *Dajani*

117. Urban Systems Planning. The history and process of urbanization. Issues in urban and regional planning. Theories of urban form and development. Examination of multi-disciplinary relationships and the systems approach to comprehensive planning. Introductory model building and systems evaluation techniques. Planning and design methodologies in the land-use, transportation, public utilities, housing, and urban service sectors. Plan implementation and control issues of city management. Prerequisite: junior or senior standing; open with consent of instructor to students from all urban-related disciplines. One course. *Dajani*

123. Water Resources Engineering. Hydraulics of pressure conduits and measurement of flow, compound pipe systems, analysis of flow in pressure distribution systems, descriptive and quantitative hydrology applied to problems of irrigation and drainage, open channel flow, reservoirs and distribution system storage. Selected laboratory work. Prerequisite: Engineering 145. One course. *Muga*

124. Environmental Engineering. Qualitative and quantitative physical, chemical, and bacteriological characterization of water and wastewater. Introduction to water treatment processes, and wastewater collection, treatment and disposal systems; elements of environmental sanitation. Laboratory included. Field trips to be arranged. Corequisite: Engineering 145 or consent of instructor for non-civil engineering students. One course. *Vesilind*

126. Sanitary Engineering Design. Design of facilities for providing an adequate supply of water of good quality, and means for collection, treatment, and disposal of municipal and industrial wastewaters. Location and design of treatment works. Field trips to be arranged. Prerequisite: CE 124. One course. *Vesilind*

127. Environmental Pollution. A study of the environment—causes and effects of air, land, and water pollution. Interactions between the environment and stresses to which it is subjected as a consequence of growth and concentration of populations and their increasing demands on natural resources. For non-civil engineering juniors and seniors. One course. *Vesilind*

131. Structural Analysis I. An introduction to the process of applying the engineering method in the creation of structures. A unified treatment of statically determinate and indeterminate structural systems. Prerequisites: Math 73 and CE 73 or Engineering 75. One course. *Brown and Utku*

133. Structural Design I. Nonhomogenous materials. Determination of physical and mechanical properties of construction materials. Theory and design of compression and flexural members. Emphasis on ultimate strength theory for concrete. Timber design using mechanical fasteners, selected design problems in concrete to include form and timber supports. Prerequisite: CE 131. One course. *Palmer*

134. Structural Design II. Design in metals, primarily steel. Properties of materials as criteria for failure. Tension, compression, and flexural members. Riveted, bolted, and welded connections, including eccentric connections. Built-up members. Design by elastic and plastic methods. Selected problems to include computations and drawings. Prerequisite: CE 131. One course. *Palmer*

139. Introduction to Soil Mechanics. Origin and composition of soils; soil structure. Flow of water through soils; capillary and osmotic phenomena. Soil behavior under stress; compressibility, shear strength. Elements of mechanics of soil masses with application to problems of bearing capacity of foundations, earth pressure on retaining walls, and stability of slopes. Laboratory included. Prerequisites: Engineering 83 and 145. One course. *Clough and Vesic*

140. Structural Analysis II. An elective course for students who have a special interest in structures. Fundamental and special methods applied. Introduction to limit design and to matrix and computer methods. Prerequisites: CE 131 and Math 74. One course. *Brown and Utku*

141, 142. Special Topics in Civil Engineering. Study arranged on a special topic in which the instructor has particular interest and competence as a result of research and professional activities. Prerequisite: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. *Staff*

197, 198. Projects in Civil Engineering. These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisite: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. *Staff*

201. Advanced Mechanics of Solids. Cartesian tensors. Analysis of states of stress and strain, field equations. Constitutive relations for elastic, viscoelastic, and elastic-plastic solids. Energy principles. Virtual work techniques, limit analysis. The correspondence principle. Application to bars, beams, shafts, beams on elastic foundations, and pressure vessels. Simple torsion and plane problems. Corequisite: Mathematics 285 or equivalent. One course. *Dvorak*

202. Experimental Mechanics. Types of measurements and instrumentation used in fluid, soil, and solid mechanics; static and dynamic modeling theory; stress-strain analysis using photoelasticity and strain gages. Offered 1974-1975 and 1976-1977. One course. *J. F. Wilson*

203. Elastic Stability. Linear buckling problems of structures in continuum such as bars, rings, beams, curved beams, thin plates, and thin shells. Linear buckling of structures in discrete space, such as trusses, frames, and discrete representations of plates and shells. Differential equation formulations versus extremum formulations in linear bucking problems. Systematic treatment of buckling problems as linear eigenvalue problems in discrete space and in continuum. Numerical methods for eigenvalue extraction. Offered 1974-1975 and 1976-1977. One course. *Utku and Wilson*

204. Plates and Shells. Formulation of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian thin plates of isotropic and orthotropic materials. Solutions in terms of previously tabulated functions. Finite difference methods. Extremum formulation of the plate problem. Finite difference and finite element methods as applied to the extremum formulation. Folded plates. Numerical solution methods for the folded plates. Membrane theory of thin shells. Offered 1974-1975 and 1976-1977. One course. *Utku*

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending, and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Offered 1974-1975 and 1976-1977. Prerequisite: CE 201 or equivalent. One course. *Dvorak*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies, and generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis. (Listed also as Mechanical Engineering 210.) One course. *J. F. Wilson and Macduff*

211. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: Civil Engineering 201. One course. *Dvorak*

217. Urban Systems Analysis. Quantitative approaches to the analysis of public services, activities, and facilities. Model building. Demand forecasting, cost, performance, and impact models. Planning methodologies and system evaluation techniques. Optimization of urban and regional systems. Emphasis on transportation, housing, land use, and public utilities and services. Prerequisites: Civil Engineering 117 and Engineering 171 or equivalent. One course. *Dajani*

221. Incompressible Fluid Flow. Steady and unsteady pipe flow, theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluid systems; effect of resistance; tapered conductors. Offered 1974-1975 and 1976-1977. One course. *Muga*

222. Open Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, energy dissipators. Offered 1974-1975 and 1976-1977. One course. *Muga*

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivation and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthern dams, dewatering of construction sites, well point operation. Offered 1974-1975 and 1976-1977. One course. *Muga*

224. Coastal and Offshore Engineering. Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. Offered 1973-1974 and 1975-1976. One course. *Muga*

225. Engineering Hydrology. Study of processes governing the origin, distribution, and depletion and replenishment of water resources, and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometerology, precipitation, runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. Offered 1973-1974 and 1975-1976. One course. *Vesilind*

230. Matrix Methods in Structural Analysis. A study of the displacement method of structural analysis and the use of matrices in the analysis of rigid frames and trusses; application to multispan and multistory frames and space trusses. Computer solutions are emphasized. Offered 1973-1974 and 1975-1976. Prerequisite: CE 140. One course. *Brown*

231. Structural Engineering Analysis. A study in the depth of a number of "classical" topics in structural analysis, such as elastic arch design; plasticity and limit design; numerical and approximate methods of beam deflection analysis. Computer solutions of structural problems. Offered 1974-1975 and 1976-1977. One course. *Brown*

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, shear and diagonal tension. Two-way slab and flat plate design. Offered 1974-1975 and 1976-1977. Prerequisite: CE 133. One course. *Brown*

233. Prestressed Concrete Design. A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Offered 1974-1975 and 1976-1977. Prerequisite: CE 133. One course. *Brown*

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Offered 1973-1974 and 1975-1976. Prerequisite: CE 134. One course. *Palmer*

235. Foundation Engineering. An introduction to methods of analysis, design, and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; underpinning. Foundation vibrations. Offered 1974-1975 and 1976-1977. One course. *Vesic and Clough*

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures such as dams, embankments, cuts, canals, airfield, and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. Offered 1973-1974 and 1975-1976. One course. *Clough*

243, 244. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. Two courses. *Vesilind*

247. Air Pollution Control. The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, air pollution law. One course. *Vesilind*

248. Solid Waste Management. Collection, treatment, and disposal of solid wastes from wastewater treatment. Filtration and centrifugation theory and application. Pumping of solid-liquid mixtures. Sludge conditioning by chemicals and heat. Sludge combustion, pyrolysis, and drying. Application of systems analysis to collection of municipal refuse. Sanitary landfills and incineration of solid wastes. Reuse and recycling. Prerequisite: CE 124 or consent of instructor. One course. *Vesilind*

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem-solving techniques. One course. *J. F. Wilson*

Departmental Major in Civil Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. Specific courses which must be included are: Engineering 11 (half-course), 75, 83, 104, 123, 145; CE 16 (half-course), 116, 123, 124, 131, 133, 134, 139; and EE 63.

ELECTRICAL ENGINEERING

Professor Owen, *Chairman;* Professor Marinos, *Director of Undergraduate Studies;* Professors Artley, Kerr, Meier, Nolte, Pilkington, Thurstone, and Wilson; Visiting Professor Trickey; Associate Professors Hacker, Joines, Wang, and Wells; Adjunct Associate Professor Olive; Assistant Professor George

Electrical Engineering is a broadly based discipline dealing with the processing, control, and transmission of information and energy by making use of the electrical and magnetic forces of nature. A partial listing of in-depth technical programs possible under the electrical engineering curriculum at Duke follows: communication systems, computer systems design, information science, electronics-networks, electromagnetics, physical electronics, control systems, energy conversion, applied mathematics, and applied physics. Students with other interests such as premedicine, prelaw, computer science, management, economics, art and music, psychology, and social systems may also be accommodated within the curriculum. These programs are individually designed and, in addition to stressing the acquisition of specific skills and methods seek, in both the classroom and laboratory, to stimulate students to think creatively in terms of fundamental concepts.

Opportunities for research and project work are available in the following research and teaching laboratories: The Solid State Sciences Laboratories are concerned with both the microscopic and macroscopic properties of materials with emphasis on electric and magnetic phenomena such as magnetic susceptibility, paramagnetic resonance, electrical conductivity, and magnetic ordering transitions. In the Thin-Films Laboratory investigations are directed toward physical properties of thin films which provide bases for applications in electronic and computer systems. The Electronics Laboratory is used for the study of the physical behavior of basic electronic components and of advanced electronic devices and circuits. The Energy Conversion Laboratory is concerned with the generation, transformation, and control of energy in large-scale power systems and small self-contained systems. The Automatic Control Systems Laboratory deals with the principles underlying instrumentation and control of physical processes. The Spacecraft Systems Laboratory combines all phases of electrical engineering in solving problems encountered in modern spacecraft technology. The Controlled Personal Environment Laboratory provides experimental learning activities directed to the understanding of the self and the interaction of the self with others and a carefully controlled physical environment. The Machine Intelligence Laboratory is concerned with the design of adaptive and learning control systems for various applications. In the Electromagnetic Waves Laboratory studies are made of microwave networks and the interaction of electromagnetic waves with biological systems. The Minicomputer Laboratories provide the opportunity for hands-on experience in the operation of two small computers in an instructional and research environment. The Digital Systems Laboratories are utilized for research and instruction in digital systems design and simulation. The Adaptive Information Processing Laboratory is concerned with the formulation and performance evaluation of adaptive algorithms for extracting signals and information from noise.

42. Introduction to Digital Systems. A course designed for students who have no previous exposure to switching (Boolean) algebra. Its main objective is to introduce basic notions of switching algebra and to demonstrate the application of these concepts to digital systems design. The operational characteristics of major digital subsystems such as memories, central processing elements, arithmetic units, and input/output devices are discussed in detail, and a general-purpose digital computer system with a simple architecture is functionally analyzed. Selected laboratory work is required. Fall and spring semesters. (Listed also as Computer Science 42.) One course. *Marinos and Owen*

63. Electric Networks. Complete analysis (transient and steady state) by transform methods of linear lumped parameter networks. Application of modern analysis techniques to contemporary electrical engineering problems. Laboratory included. Prerequisite: Physics 51. Corequisite: Math 73. Fall and spring semesters. One course.

103. Introduction to Nonlinear Network Theory. Introduction to theory and techniques for analysis and synthesis of nonlinear circuits. Characterization of 2-, 3-, and n-terminal nonlinear network elements. Laws for interconnecting elements and determining equilibrium equations. Operating points, driving-point and transfer-characteristics plots. Graphical and numerical analysis and synthesis of dc and ac nonlinear resistive functional networks. Nonautonomous first-order nonlinear networks, and autonomous second-order nonlinear networks. Method of isoclines. Some laboratory and computer simulations. Prerequisite: EE 63. Fall semesters. One course. *Wilson*

113. Introductory System Theory. Modeling of physical systems and mathematical representations of dynamic systems. The concept of states, inputs, outputs, and systems. Classification of systems and types of input; Fourier series and transforms. Solutions of vector differential and difference equations. Properties of multivariable systems, equivalent representation and minimum realization of a transfer function matrix. Introduction to stochastic systems. Analog and digital computer simulation. Prerequisites: EE 63 and Math 73. Fall and spring semesters. One course.

143. Fields and Continua. This course introduces the physical concepts used in the description of fields and continua and relates these concepts to mathematical descriptions which permit a quantitative treatment of phenomena of interest to the engineer. Physical fields include: fluid flow, thermal (heat flow), radiation, electric, magnetic, electromagnetic, and stress-strain fields. Laboratory and computer applications will be used to assist in the learning of the material. Prerequisites: Math 74 and Physics 52. Spring semester. One course.

155, 156. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor. Each half-course or one course. *Staff*

157. Introduction to Switching and Automata Theory. This course introduces techniques for the analysis and design of combinational and sequential networks. Discrete mathematical systems; elements of code theory; threshold logic; functional decomposition; minimum-complexity combinational and sequential networks; asynchronous and clocked sequential systems; iterative switching structures; Turing machines; fault diagnosis techniques. Selected laboratory work. Normally open to juniors and seniors. Fall semester. (Listed also as Computer Science 157.) One course. *Marinos*

161. Electronic Circuits. Graphical and mathematical modeling of electronic devices such as diodes, bipolar-junction and field-effect transistors, and vacuum tubes; techniques for the analysis and design of electronic circuits with emphasis on graphical, piece-wise linear, and small-signal methods; applications of these methods to particular circuits, including regulators, bias-point stability, amplifiers, and switching circuits; computer simulation of electronic circuits using ECAP. Three class sessions and one computation or laboratory session. Prerequisite: EE 63. Spring semesters. One course. *Wilson*

162. Electromechanical Energy Conversion. Principles of energy storage and conversion utilizing magnetic and electric fields; analytical treatment of dynamic equations of motion, including the Euler-Lagrange approach; applications to the design of electromechanical transducers and rotating machines. Prerequisites: EE 113 and 143. One course. *Trickey*

163. Physical Electronics. Study of physical processes under the influence of electric, magnetic, thermal, and stress fields with contemporary electrical engineering applications: e.g., transistors, thermoelectric energy converters, and magnetic devices. Three class sessions and one computation or laboratory. Prerequisite: EE 143. One course. *George and Hacker*

164. Electromagnetic Fields and Waves. Electric and magnetic fields; Maxwell's equations developed from Coulomb's, Ampere's and Faraday's laws and the solenoidal nature of the magnetic field; electrostatics; magnetostatics; quasistatic, and stationary fields; electromagnetic waves; retarded potential; relaxation time, reflection, polarization, and radiation of electromagnetic waves; transmission lines; probability waves in periodic structures. Three class sessions and one computation or laboratory. Prerequisite: EE 143. One course. *Artley and Joines*

167. Design Colloquium. A course planned to guide the student in learning how the fundamental principles studied in the academic program are translated into the realities of engineering practice. The vehicle will be an extensive and intensive study of a significant modern engineering project. Extensive reference to published information and possible site visits to the projects will be part of the mode of operation, as will written and oral reports. One course. *Meier*

173, 174. Projects in Electrical Engineering. A course which may be undertaken only by seniors who are enrolled in the Graduation with Distinction program, or who show special aptitude for individual project work. Consent of the Director of Undergraduate Studies required. Elective for electrical engineering majors. Half-course to two courses. *Staff*

185. Pulse and Digital Electronics. Generation and shaping of waveforms encountered in information processing systems, such as radar, computer, control, and instrumentation. Typical circuit functions included are linear and nonlinear wave shaping, pulse and time-base generation, time delay, counting, and gating. Emphasis on the application of semiconductor devices to the realization of circuit functions. Three class sessions and one computation or laboratory session. Prerequisite: EE 161. One course. *George*

186. Modulation Systems and Noise. Analysis and design of modulation systems. Description of deterministic and probabilistic signals; power spectra; sampling theory; amplitude-, frequency-, and pulse-modulation systems, pulse-modulation techniques. Sources and characteristics of noise; comparison of various modulation techniques. Sources and characteristics of noise; comparison of various modulation systems. Selected laboratory work. Prerequisite: EE 161. One course. *Nolte and Wang*

187. Electronic Processes in Materials. Prediction and explanation of the response of ferroelectric, magnetic, superconductor, and semiconductor materials to thermal, electric, magnetic, and stress fields. Exploration of possibilities of improving the materials. Three class sessions and one computation or laboratory. Prerequisite: EE 163. One course. *Hacker*

188. Dynamics of Electrochemical Energy Conversion. An analytical and experimental study of the dynamic characteristics of electromechanical energy conversion devices that are utilized in both control and power applications. Three class sessions and one three-hour laboratory. Prerequisite: EE 162. One course.

196. Microwaves and Quantum Electronics. A study of the special field and circuit techniques required at microwave frequencies; electromagnetic wave propagation in unbounded and bounded media; transmission and reflection properties of various microwave networks. Equivalent circuits and matrix methods will facilitate analysis. Discussion of microwave amplifiers and oscillators, including klystrons, magnetrons, traveling-wave tubes and masers. Selected laboratory experiments. Three class sessions and one computation or laboratory. Prerequisite: EE 164. One course. *Joines*

199. Linear Control Systems. Analysis and design of linear, continuous, and sampled data control systems. Feedback principles and servomechanisms. Stability criteria and tests; performance specifications. Regulation and control from a state variable viewpoint; system constraints and performance optimization; system sensitivity to noise and parameter variations. Laboratory simulations on analog and digital computers. Prerequisite: EE 113 or permission of instructor. Spring semesters. One course. *Kerr and Wang*

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. Fall semesters. (Listed also as Computer Science 203.) One course. *Kerr and Nolte*

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Spring semesters, 1974, 1976. Prerequisite: EE 203. One course. *Marinos and Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, decision processes with finite memory. Applications to problems in communication theory. Spring semesters. (Listed also as Computer Science 205.) Prerequisite: EE 203 or permission of instructor. One course. *Nolte*

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also covered. Selected laboratory work is required. Spring semesters. Prerequisite: EE 157 or permission of instructor. (Listed also as Computer Science 208.) One course. *Marinos and Owen*

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrödinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: permission of instructor. Fall semesters. One course. *George and Hacker*

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric, magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; superconductors. Prerequisite: EE 211. Spring semesters. One course. *Artley and Hacker*

213. Principles of Magnetism. A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: permission of instructor. One course. *Artley and Hacker*

215. Semiconductor Physics. A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: EE 211 or permission of instructor. One course. *Hacker*

217. Masers. Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Two class sessions and laboratory. Spring semesters, 1975, 1977. Prercquisite: permission of instructor. One course. *George*

222. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semesters. (Listed also as ME 232.) One course. *Wilson*

225. Semiconductor Electronic Circuits. Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models; switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Spring semesters. Prerequisite: EE 161 or permission of instructor. One course. *George*

227. Network Synthesis. Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Fall semesters, 1974, 1976. Prerequisite: permission of instructor. One course. *George*

242. Modern Control and Dynamic Systems. The statespace point of view is used as a vehicle to integrate the classical control and modern systems techniques. Topics include vector differential equations, modal matrix transformation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Listed also as ME 230.) One course. *Wright*

243. Advanced Linear Systems Theory. Linear spaces and linear operators, mathematical description of systems, controllability and observability of Jordan form dynamical equations; multivariable and composite systems; state feedback and state estimators, equivalent systems and minimal realizations. Observer theory. Design of poleplacement compensators. Study of technical papers from various journals. Prerequisite: EE 242 or equivalent. Fall semesters. One course. *Wang*

259. Advanced Electric Energy Conversion. Equations of motion of electromechanical systems; fields and lumped parameters, state function concepts; mathematical techniques for analyzing electromechanical devices and systems; transducers; unified treatment employing matrix, tensor, and block-diagram concepts to obtain response under static and dynamic conditions; the generalized rotating machine. Prerequisite: permission of instructor. One course. *Trickey*

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisite: approval of the Director of Undergraduate Studies and of instructor under whom work will be done. One course. *Staff*

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, force and energy relations. Three class sessions. Fall semesters. Prerequisite: permission of instructor. One course. *Joines*

272. Application of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Spring semesters 1974, 1976. Prerequisite: EE 271. One course. *Joines*

Departmental Major in Electrical Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. The specific courses EE 63, 113, and 143 must be included.

MECHANICAL ENGINEERING

Professor Chaddock, *Chairman;* Associate Professor Shepard, *Director of Undergraduate Studies;* Professors Garg, Harman, Kenyon, Linderoth, Macduff, and Pearsall; Associate Professors Clark, Cocks, and Elsevier; Assistant Professors Buzzard, Munson, and Wright

The Mechanical Engineering Department is organized in three areas: design and control of machines and processes, materials science and development, and thermal and fluid systems. These areas are the special fields of competence of the faculty, and are representative of the educational and research activities of the department. They are inadequate, however, to inform the prospective student of the broad program opportunities which can be developd within the mechanical engineering curriculum. These include: automatic control, biomechanics, business management, combustion engineering, environmental quality and control, heat and mass transfer, materials processing, mechanical design, ocean engineering, power and propulsion, transportation technology, and vibrations and noise control.

Undergraduate laboratories provide unique learning experiences and assist in the development of professional attitudes and approaches to typical engineering problems. The System Dynamics Laboratory introduces fundamentals of instrumentation and dynamic system responses through simulation techniques. The Materials Laboratory has equipment for the preparation, testing, and microscopic examination of metals, polymers, ceramics, as well as naturally occurring materials. The Thermal and Fluid Systems Laboratory involves the student in the analysis of thermal and fluid systems and introduces experimental techniques for the measurement of physical and thermodynamic properties. The System Response and Control Laboratory emphasizes computer simulation of feedback systems and familiarization with associated hydraulic and pneumatic automatic control components. Oral and written reports are an integral part of the Senior Projects Laboratory in which a student identifies a need for experimentation, designs his "model," and instruments it to provide the desired data on an advanced project.

31. Engineering Applications of Digital Computation. An introduction to digital computation, including preparation of mathematical models from physical parameters. Programming the model for the digital computer. Applications are drawn from the basic areas of mechanical engineering and include propulsion, power, machines, and transport. One course. *Buzzard and Garg*

101. Thermodynamics. An introduction to both classical and statistical thermodynamics. The laws of classical thermodynamics are presented and applied to open and closed systems. Continuum properties, processes, and cycles are included. Molecular distribution and property evaluation, especially entropy, are considered from the statistical and quantum viewpoints. Prerequisites: Physics 51 and Math 73. One course. *Harman, Elsevier, and Kenyon*

102. Thermodynamics II. Continuation of the study of the basic laws and processes of thermodynamics with emphasis on energy conversion and property evaluation. Included are combustion and chemical equilibrium, gas mixtures and psychrometrics, and power cycles. One course. *Elsevier and Kenyon*

111. Physical Metallurgy. Extension of the principles of Engineering 83 to the metallic state; atomic, experimental, and thermodynamic approaches to metallurgy; phase transformations and hardening mechanisms, relationships between the structure of alloys and plastic behavior with emphasis on engineering alloy systems. Prerequisite: Engineering 83. One course. *Shepard, Cocks, and Pearsall*

112. Polymer Science. Extension of the principles of Engineering 83 to high molecular weight polymers, especially those which have significant engineering applications; structure and properties of polymers; polymerization mechanisms; properties of commercial polymers; polymer processing. Prerequisite: Engineering 83. One course. *Clark and Pearsall*

123. Dynamics. General principles of dynamics as applied to particles, rigid bodies, and selected nonrigid systems with emphasis on the formulation of engineering problems. Absolute and relative motion analysis. Work-energy and impulse-momentum methods. Introduction to kinematics and kinetics in three dimensions and to Lagrange's equations using generalized coordinates. Prerequisites: Physics 51, Math 73, and Engineering 75. One course. *Macduff and Wright*

126. Fluid Mechanics. An introductory course emphasizing the application of the principles of conservation of mass, momentum, and energy to a fluid system. Physical properties of fluids; dimensional analysis and similitude, viscous effects and integral boundary layer theory; subsonic and supersonic flows; normal shock waves. Selected laboratory work. Corequisites: ME 123 and 101. One course. *Buzzard and Munson*

135. Vibration Control. An introduction to the dynamics of mechanical systems; equilibrium, stability, lumped and distributed systems. System analysis by classical differential equations, mechanical impedance, and computer methods. Prerequisites: Math 73 and Engineering 72. One course. *Macduff*

136. Response of Systems. System design for optimum dynamic response. Development of mathematical models from physical systems, operational and computer techniques, matrix methods for lumped and distributed systems, instrumentation and testing of components and systems, effect of nonlinearities. Prerequisites: Math 74, ME 123, and Engineering 72. One course. *Macduff and Wright*

141. Mechanical Design I. A study of the broad aspects of mechanical design starting with the creative process and considering the effects of economics, human factors, ethics and prior art on design. Basic mechanical components such as gears, cams, bearings, springs, shafts, etc. will be introduced in the discussions so that the student will become familiar with their design and application. A term design project will serve to practice the application of the design process. Prerequisite: ME 123. One course. *Linderoth*

142. Kinematics and Dynamics of Machinery. Study of the geometry of mechanisms. An introduction to the mathematics of gears, cams, linkages, and intermittent motion devices. The kinematics and kinetics of linkages. Computer solutions for linkage problems. Prerequisite: Math 73. Corequisite: Engineering 123. One course. *Linderoth*

143. The Design of Machine Elements. The detail design of machine elements. Study of the problems of stress and strain (deflections) as they affect and modify design requirements. Reliability and safety as design parameters. Prerequisite: ME 141. One course. *Linderoth*

150. Heat and Mass Transfer. Study of the mechanisms of heat transfer processes. Steady and transient conduction in solids, numerical and graphical methods; heat exchanger design, performance; thermal radiation; convective processes, turbulent and laminar flow, steady and transient diffusion, mass transfer between phases. Prerequisites: ME 126 and Math 74. One course. *Chaddock and Buzzard*

153. Heating, Air Conditioning, and Refrigeration. Principles of thermodynamics, heat transfer, and fluid flow applied to comfort and industrial air conditioning. Cycles and equipment for heating, cooling, and humidity control. Air transmission and distribution. Modern vapor compression, absorption, and low temperature refrigeration cycles and systems. Prerequisite: ME 101. One course. *Elsevier*

156. Combustion Engines. A study of cycles, fuels, and fuel mixtures in piston, ram jet, and rocket engines. Comparison of real and theoretical cycles; carburetion and fuel injection systems; modern developments. Prerequisite: ME 101. One course. *Elsevier*

165, 166. Special Topics in Mechanical Engineering. Study arranged on a special engineering topic in which the faculty has particular interest and competence as a result of research and professional activities. Prerequisite: permission of the instructor and Director of Undergraduate Studies. Each half-course or one course. *Staff*

173. Ocean Engineering. An introductory course to acquaint the student with the basics of physical and chemical oceanography and the need for and application of engineering knowledge and methods to the design and operation of structures, vehicles, and communications systems for use on and in the oceans. Prerequisite: junior standing in any department. One course. *Linderoth and Muga*

177. Computer Techniques for Simulation and Design. Modern analog and digital computation used in the design of advanced engineering systems. Problems described by linear and nonlinear differential and algebraic equations will be solved. Linkage-cam mechanisms, heat exchangers, rocket nozzles, missile roll control, and aircraft stability are typical problem topics. One course. *Wright*

182. Fundamentals of Nuclear Engineering. Review of nuclear physics, nuclear interactions and cross sections, neutron induced chain reactions, shielding, hazards, isotope utilizations, reactor systems, and power reactors. Prerequisite: permission of instructor. One course. *Kenyon*

183. Power Plants. Basic concepts of thermodynamics, heat transfer, and fluid flow are combined with industrial data for the consideration of real power plant problems. Selection of steam generators, prime movers, fans, pumps, heaters, and piping systems with regard to engineering and economic points of view. One course. *Kenyon*

197, 198. Projects in Mechanical Engineering. This course may be assigned by the chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisites: *B* average and senior standing. Half-course to two courses. *Staff*

202. Theoretical Thermodynamics. Classical thermodynamics and thermodynamics continuum properties for real substances, equilibrium, introduction to statistical thermodynamics. One course. *Elsevier and Harman*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies, and generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis. (Listed also as CE 210.) One course. *J. F. Wilson and Macduff*

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention is paid to recent developments in the processing and use of modern plastics and fibers. Product design is considered in terms of polymer structures, processing techniques, and properties. One course. *Pearsall and Clark*

214. Environmental Factors in Materials Science. Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. One course. *Shepard and Cocks*

215. Failure Analysis and Prevention. A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or permission of instructor. One course. *Cocks and Shepard*

221. Compressible Fluid Flow. The concepts and analysis for flow of gases in subsonic to hypersonic regime. Two-dimensional flow; oblique shocks; experimental techniques. One course. *Harman and Munson*

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. One course. *Chaddock and Buzzard*

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional imcompressible potential flow and to viscous flow in boundary layers. One course. *Buzzard and Munson*

230. Modern Control and Dynamic Systems. The statespace point of view is used as a vehicle to integrate the classical control and modern systems techniques. Topics include vector differential equations, modal matrix transformation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-paramcter systems. Modal control of multivariable control systems. One course. *Wright and Garg*

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies of mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. One course. *Macduff and Wright*

232. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semesters. Prerequisite: permission of instructor. (Listed also as EE 222.) One course. *Wilson*

233. Fluid Control Systems. A design oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; DC and AC hydraulic and pneumatic amplifiers. One course. *Macduff and Munson*

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. One course. *Macduff*

236. Engineering Acoustics and Noise Control. Specification of the physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personal protectors. Prerequisites: ME 123 and Math 111. One course. *Macduff*

251. Refrigeration and Cryogenics. Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Thermodynamics of vapor compression, air cycle, absorption, and thermoelectric refrigeration. Production of low and very low temperatures, helium liquifiers. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. One course. *Chaddock*

255. Energy Conversion. Principles, thermodynamics, and classification of energy conversion devices. Introduction to semiconductors, thermoelectric generators, photovoltaic generators, thermionic generators, magnetohydrodynamic generators, fuel cells, and other energy conversion devices. One course. *Harman*

265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor under whom work will be done. One course. *Staff*

270. Theory of Lubrication and Bearing Design. A study and analysis of the theory of hydrodynamic and hydrostatic lubrication will be presented. The dynamics of bearing loading, bearing design, and materials will be examined in their relationships to the theory of lubrication. Properties of lubricants will be reviewed. The student will have ample opportunity to put theory into practice with real bearing problems taken from industrial machinery, construction equipment, transportation media and wherever relative motion is required between adjacent surfaces. One course. *Linderoth*

280. Nuclear Reactor Power Cycles. Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow, and materials problems unique to reactor design. One course. *Kenyon*

Departmental Major in Mechanical Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. Specific courses which must be included are: Engineering 72, 75, 83; ME 101, 123, 136, 141, and either ME 126 and 150, or ME 111 and Engineering 122.

Appendix

DEGREES AWARDED MAY 14, 1972

Bachelor of Arts

William David Aaron, Jr.
Charlotte Burton Adams
Thomas Richard Adams
Melinda Anne Agsten
Pamela Ann Aiken
Edward Charlie Akel
Heath Aldridge
William Rowan Allder, Jr.
Etres Biddle Allen
Kenneth Douglas Allison
Karen Jurgens Amrhine
Nick George Anas
Stanley S. Anders, III
Stephen Woodard Anderson, II
Robert Edward Ansley, Jr.
Gail Constance Arneke
Robert Gordon Atcheson
Frederick Gould Aten, Jr.
David Mitchell Atwell
Wendy Ann Augustus
Marjorie Susan Axelrod
Carolyn Sharon Bacal
David Macleod Bachelder
John Oliver Bacon
Martha Lucille Bagby
Gregory Baird
William Michael Baker
Ellen Prince Banks
David Hughes Barber
Molly Anne Barber
Steven Richard Barker
Brit Jeffrey Bartter
Roy Howard Baskin, III
Larry Fredrick Bassman
Steve Anthony Batchelor
Donald Leahy Baumgartner
Anne Spencer Beach
Pheon Elizabeth Beal
Pamela Carroll Beam
Kathryn Marie Beamer
Ralph Harrison Beaumont, III
Robert Edmond Bechtold
Arthur L. Becofsky
Catherine Jean Behrens
Sue Ensor Behringer
Charles Calvert Benedict, III
Frederick Raymond Benson
David Henry Bernanke
David Edwin Berry
William James Berry, III
George E. Bers
Richard August Bersin
John Edmund Bickel, Jr.
Karen Ruth Bird
Benjamin Franklin Black
Lawrence Eley Blanchard, III
Thomas Steven Bland
Brian Quentin Bochow
Barry Alan Bohrer
Barbara Boone
George Stephen Bos
Arthur E. Bosetti
Daniel Lee Bottom
Robin E. Bounous
Arlene Doris Bowers
Victoria Estelle Bowman
Myer William Boyarsky
Howard Michael Boyd
Robert Henderson Bradley
Mary Jean Brady
Myrna Lois Brake
Jeffrey Lynn Brandon
Christopher Michael Brandt
Charles Brasher
Karen Ann Braumiller
Mark Joel Brenner
Deborah Ann Brian
Beth Carol Bridgers
James Edwin Briley, III
Cathy Scott Brizendine
David Arthur Brodsky
Marie Elisabeth Katz Brodsky
Robert A. Broughton
Phillip David Browarsky
Robert Brown, Jr.
Sara Estes Brown
Susan Evans Brown
Gordon Lanfear Browne
Karyn DeKlyne Browne
William Charles Buchanan
Thomas Barry Buescher
Linda Jeanne Burdette
Robert Edward Burgin
Donald Edward Burkins
Ronald Gibson Burns
Mary Frances Burt
Craig Emmons Buschman
Dianne Elizabeth Butler
Elizabeth Ann Butler
Robert Lowe Byrd
Thomas Paul Cain
Cathleen Dru Cake
John Wieters Califf, III
James Michael Callahan, Jr.
Elizabeth Walton Callaway
Claudia Vann Camp
David Frederick Campbell
John Lawrence Campbell

Nancy Elizabeth Campbell
Jonathan Ira Carmel
Joseph Penn Carolan, III
David Eric Carpenter
Terry Ann Carpenter
George E. Carr
Candace Elisabeth Carraway
Christine Ann Carroll
William Edmond Carroll
Carol Sutton Carruthers
Barry Randall Carter
Elizabeth Jeanine Carver
Phyllis Cheryl Salisbury Casavant
Dennis M. Cassidy
Mildred Alyce Cayer
E. Gregory Cehan
Candace Irene Chandler
Richard Gardiner Chaney
John Davidson Cheesborough
Stephen Nicholas Cherewaty
Emily Esther Christenberry
Margaret Lynn Clark
Susan Jane Clark
William M. Clowdus
Janice Ruth Coddington
Reagan Ransom Coker
Richard Lindahl Coleman
John Charles Collins
John McClellan Collins
Robert Meck Comfort
Russel C. Cook
James Harbin Cooke, Jr.
John Michael Copacino
Wade Kyle Copeland
Stephen Michael Corriher
Charles D. Courtney
Richard P. Cowperthwait
James Calhoun Cox, Jr.
Jeffrey Ellis Cox
Peter Joseph Coyle, Jr.
Barnette C. Crabtree
Russell Lamont Creighton
Lucy Gail Crockett
Douglas Henry Cromwell
Danny Calvert Crowe
Sara Elizabeth Cushing
Edith Gossett Dalton
Diane Marie D'Angelo
Jerome Madsen Daniel
Susan Elizabeth Darrow
John Franklin Daugherty
William Lee Davidson
Michael E. Davies
David H. Deacon, Jr.
Melinda Lamar Dempster
Donna Marie Dennis
Paul M. Dennis, Jr.
Robert C. A. de Vos
Joshua Vernon Deweese
Mary Elizabeth Dinkins
Annette Dixon
Brian Richard Donnelly
Brad Leslie Doores
Richard Marion Dorset
Patrick Jay Doughty
Kathryn Nadine Downs
Robert Wagner Drake
Thomas L. Drew
Linda Anne Duke
Kristin Dulcan
John Curt Dull
Robert Kilpatrick Dunn
Susan King Dunn
Jane Earle Dunning
Richard Wayne Eakin
Barbara Jane Eason
James Warren East, Jr.
Mary Jane Eaton
Virginia Tebyrica Eaton
Jonathan Paul Edwards
Maurice Michael Egan, Jr.
Gail L. Eggleston
Thomas Willis Eiden
Sarah Marshall Ellett
John Samuel Elliker, Jr.
Stephen M. Emerson
James C. Erickson
Sue Ellen Estroff
Lydia Gayle Eure
Bradford Lee Evans
David Shirk Evans, Jr.
Clyde Preston Evely
Catherine Joyce Everett
Michele Elisabeth Faber
Derek Blakely Fahey
Susan Katherine Falk
Allen V. Farber
Charles Eric Farrell
Steven Julius Fay
Henry Adam Fedziuk, Jr.
Jack T. Feldman
Donna Ruth Ferguson
John Ramsey Ferguson
Jimmy Hinson Fernandez
Catherine Janet Fetterolf
John Thomas Fielder, Jr.
Vary B. Finlay
Joan I. Fiore
Mark Stephen Fischer
Lawrence Pursell Fisher
Stewart W. Fisher
Robert Douglas Fitch
Katherine Ann Florini
Jimmy S. Forbis
Kathryn Preston Foreman
Larry Wayne Forrester
Richard Vernon Forth
Marie Marshall Fortune
Harriett Ellen Fox
Carolyn Ann Franck
Joseph Anthony Franco, III
AmyJo Frank
Frederic Dean Fravel
Marianne Lee Frederick
Michael Ira Freedman
L. Dawn Freer

Carol Ann Friedenberg
Kenneth Harper Friedlein
Gregg Allen Friedman
Deborah Lee Fritz
Marguerite Moreau Froscher
Amy Louise Fuller
Leslie Hall Fuller
Patricia Lynn Garrett
Robert Elliott Gentry
Mary Sue George
Theodore Cairns George
Robert Charles Georgiade
David McDonald Gibbs
Sarah Elizabeth Gibson
Jerrett Lynn Giffin
Mark Scott Gilbert
Jo Ann Gillerman
Howard Mark Gillis
Vaughn Charles Glapion
James Alan Gober
Jeffrey Warwick Gold
Jeffrey Bruce Golden
Robin Elisabeth Gorog
James Ragan Gosey, Jr.
Lewis Allen Grabow
Dayna Grant
Janet Lee Grassia
William Lash Gray
Jerry James Green
Leonard Judson Green, III
Patricia Ann Carver Green
Eric Greenspan
Thomas L. Grier
Tyler Underwood Griese
Jan Sherrill Griffith
Thomas Shelden Griggs
David Bruce Grim
Robert Dillon Gross
Ronald Clay Grunke
Mary Katherine Guillory
Sidney Loy Gulledge, III
Ann Rieth Gurtler
Debborah Jean Haan
Virginia Clotilde Hair
Charles Terry Hall
Nancy Allison Haltom
Christopher Brecht Hanback
Leslie Kathleen Hankins
Judy Kaye Hanson
Sarah Elizabeth Hardesty
Kim Dennis Hardingham
William David Harkins
Holly Ann Fox Harris
Sue Elizabeth Harris
William Floyd Harris, II
Edward Calhoun Harrison
Nikita Laureano Harwich Vallenilla
Edmund C. Haskins
Nancy Lynn Hasselback
Susan Gay Haumersen
Paul Leslie Hawthorne
John P. Heard, Jr.
Kimberly Ellis Hedgecock
Barbara Louise Hedman
Sarah Ann Heldrich
John Todd Helgeson
Richard Mark Heller
Hal S. Hemme
Nancy Carr Hendricks
John Frederick Henry, Jr.
Douglas R. Henshaw
William Smith Herald
Karen Herbolzheimer
Marilyn Kay Hess
Inez Marie Higgins
Peter Lawrence Hilbig
Rama Heath Hillman
Robert Lee Hines
Elsa Ruth Hirvela
Doris Leslie Hollingsworth
John Durward Holly, III
Marilyn Jean Holmes
Charles John Holmquist, Jr.
Phyllis Kay Holshouser
James Fletcher Horn
Eugene Todd Horton, Jr.
Nancy Helen Horton
Donald Francis House, Jr.
John Aubrey Howell
Jean Elizabeth Hoysradt
John L. Hudgins
John Carol Huff, Jr.
Donna Lawson Humphrey
Nancy Rose Hunnemann
Donald Black Hunt
Frederic John Huser
Joseph Lee Hutchens
Robert Weber Hutcheson
Richard Randall Huxford
Linda Susan Hyatt
Mary Ann Igna
John Rodman Ingold, Jr.
Fred Thomas Isaf
David Van Jackson
Earnest Jackson
Walter Anderson Jackson, III
William Henry Jackson, Jr.
Barry Marc Jacobs
Robert Lee Jamerson, Jr.
Kenneth M. Jarin
Charles Brad Jenkins
Thomas S. Jenkins
Frederic Miles Jennes
Charles J. Jess
Michael Robert Joe
Alethia Joyce Johnson
Frances Mina Johnson
Robert Bruce Johnson, II
Stuart Kendall Johnson
Sylvia Dolores Johnson
Jeffrey Dickran Johnston
John Edward Johnston
Cathy Kay Jones
Christy Jones
J. Wes Jones
Jeffrey Mercer Jones

Michael West Jones
Alexandra Kaldis
Ralph Douglas Karpinos
Jerome Charles Katz
Christina Kaupe
Neal Stuart Kaye
Carol Keene
Robert Farrell Kehm
Loyd Patrick Kelly
Michael Kevin Kennedy
William Thomas Kennedy
Anne Richardson Kenney
Mark James Keough
Gregory Allan Kern
Mary-Margaret Kerr
Curtis Rollin Kimball
John Andrew Kindzierski
John David Reid-Robertson Kirkland
Kenneth Michael Kirkman
Chrysee Lynn Kline
Linda Louise Koch
Steven Hubrig Koehler
Stuart A. Kohler
Marguerite Mary Kohn
Michael Jay Kopen
Pierce Andrew Koslosky, Jr.
Thomas Joseph Kosnik
Jeffrey Jonathan Kraft
Kerry Christina Kramer
Stephen M. Kraybill
John Philip Kreager
Linda Kreer
Kenneth David Krueger
Eric Neil Kruger
Mark A. Kuhn
Jeffrey Kurzweil
Cary C. Lacklen
Dudley Boatwright Lacy
Charles M. Lakin
Douglas Edward Lam
Robert Vaughn Lamb, III
Paul Ray Lambert
Patricia Jean Lamkin
Ann Williams Lane
William Clement Lapworth
Karen L. Laughlin
David Alexis Lawer
John Stephen Lawrence, Jr.
Lynne Ann Letham
Susan Loraine Leavell
Charles Lee
Frances Emma Leftwich
Stephen Harry Letzler
Dana John Levesque
Lynette Paige Lewis
Edward H. Lieberman
Stuart Carlton Lilly
Harvey David Linder
Nancy Helen Link
Mary Alice Lipscomb
William Lowndes Lipscomb
James Allison Litle
James Arthur Littman
Robert Paul Lordi
Louis Richard Lothman
Craig Douglas Lovett
Myrna Beatrice Lubin
Diane Lubovsky
Raymond Scott Lynch
Kathryn Ann Lynn
Brenda Lynn Mabry
Donal Ian MacGregor, Jr.
Rachel McInnis Magruder
Diane Mahony
Martha Ellen Maiden
William Reinhart Maier, Jr.
Mark Nicholas Mallus
Deborah Day Malone
Charles A. Maloney
Nancy Lee Maressa
Joan C. Marinos
Thomas C. Markham
Alice Anne Martin
Anne Elizabeth Martin
Robert Graham Martz
Christopher Matthew Massad
Douglas Lewis Massingill
Elizabeth Sherrill Maul
R. Britton Mayo
Dennis George McCarty
Michael McCloskey
Randy Thorne McConnell
David Mark McCord
Marcella Nadine McCrary
William D. McEachern
Frank William McGinnis, Jr.
Michael Woodlief McKeever
Elizabeth Allston McKeithen
Edward S. McKenna
Charles Furman McLarty
Margaret Spellman McLaurin
Brian James McNally
Susan Lynn McWilliams
Joy Mease
Constance Lynne Meck
Alan Bruce Medeiros
Alan Jacob Merin
Timothy Daggett Mersereau
Peter A. Merts
Douglas Robert Meyer
Curtis R. Miles
Mark Warren Millard
Jeffrey Stephen Miller
Warren Everett Miltimore, Jr.
Gary James Minter
Brenda Jean Mismas
Judith Edwards Mitchell
deSaussure Parker Moore
Richard DeArmond Moore
Charles Richard Morgan
Stacy Kivel Morgan
Kellum Morris
Phyllis Sudduth Morris
Thomas George Mundhenk
Theodore Lance Murdock
Catherine Jane Murphy

Elizabeth Graham Murphy
Edwin Lee Murray
James C. Musselwhite, Jr.
Beth Stirling Muzzy
Charles Davison Myers, Jr.
Sally Agatha Myers
Steven A. Nagel
Stephen James Nassof
Walter Garnet Nelson
Lawrence Myrl Newark
Mary Bergson Newman
Scott Newrock
Clarence Geno Newsome
David Paul Nichols
Fenwick Tattnall Nichols, IV
Frances Sledge Nicrosi
Benito Nieves-Baez
Nita Novy
John Paul Olds
Elizabeth Hayes Olenbush
John M. Olesiuk
John Dunbar Orr
Marie Elizabeth Orr
Zoya Lucia Oryshkevich
Michael D. Packard
Ralph F. Palaia, Jr.
Marc Stanley Palevitz
Susan Sacks Paris
Lynn Stuart Parisi
Andrew Charles Parker
Jay Thomas Parker
John Parkinson
Timothy E. Parks
Diana Lee Parrish
Edward James Parrish
William Lloyd Parry
Jeanne Elizabeth Parsons
Barbara Lynn Partenheimer
Michael William Patrick
Joan Carol Pavlovich
Michael Alfred Pearson
Gary R. Peet
Robert Cocking Peithman
Kirk Patrick Pelland
Virginia Carol Perkerson
Matilda Perkins
Bruce Alan Perler
Mark Lewis Perlman
Joan Helen Peto
Charles Duvall Pettebone, Jr.
Robert Barry Peyton
Daniel C. Phelan
Joseph Massa Piepmeier
Kära Melody Pierce
David Christopher Pishko
George Robert Pogmore, Jr.
Steven Roy Pointer
Mark Adair Polokoff
Barbara Jean Kelly Post
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Johanna Sue Powers
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Mary Ann Pritchard
William Herbert Privette
Michel David Protzel
Gary Frederick Pugh
Mary Ann Purnell
Fredrika Horton Quinn
Catherine M. Radovich
George Karl Rahdert
Lydia Anna Rainey
Richard John Raman
Warren Anderson Ramey, III
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Edith Candace Rappaport
Lucy Decker Rauch
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Michael Harvey Rivner
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Walter I. Rogers
Robert Fletcher Roscow
Russell A. Rose
Richard Neil Rosen
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Patricia Ann Parmly Rossiter
Frederic Paul Rubin
Susan Duvall Ruder
Byron Dale Russell
Duane Jeffrey Russell
Joe Willingham Russell, Jr.
Robert Neil Sadler, Jr.
Scott William Salon
Anita Jeanette Sarbo
Dennis Michael Satyshur
Clara Minto Saunders
Sally Anne Saunders
Manuel H. Savatgy
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Lawrence H. Schattner
David Berkley Schaub
Teddi Ann Schlossman
Jean C. H. Schmidt
Linda Suzanne Schmidt
John Bartley Schmitt
Susan Conant Scholls
Roy Alan Schonbrun
Elizabeth Anna Schultz
David Schulz
Alan David Schwartz
Gregg Adam Schwotzer
Edgar Clayton Scofield
Douglas W. Scott

Richard Lee Scott, II
Ruth Williams Scott
Sarah Elizabeth Scott
Susan Marjorie Scott
Richard Lear Searl
David Kilton Secrest
Michael Vaughn Seitzinger
Kevin Ard Shannon
Alice LaVerne Sharpe
Amy Darlene Everhart Shaw
Robert Arnett Shaw
William Eustace Shaw
Jeffery Harris Sheetz
Nancy Jacqueline Shepherd
Lonnie Ray Sherrod
Frank Grinyer Sherwood
Katherine Louise Shockley
David Roger Sholis
Margery Sue Silverton
Charles Cass Simpson, III
Karen Ann Sindelar
Sharon Porter Sitton
Sandra Irene Skeen
Mark Edward Slaughter
Richard Groos Slaughter
Ernest Giddens Sloan
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Gail Fletcher Smith
J. Christopher Smith
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Mowry Smith, III
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Benjamin Lawrence Somberg
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Linwood Earl Stevens
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Jacqueline Todd Stillman
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Thomas Jeffrey Swilling
Lawrence John Synal
Mary Murrell Synal
Stephen G. Takacs
Alice Martin Taylor
Jean Paris Taylor
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Suzanne Elizabeth Taylor
Joan Allen Teitelbaum
Nicholas Jon Tennyson
Doris Ellen Terry
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Lillian Greenlee Trexler
Gano Tschudy
Althea Ann Turner
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Charles Dwyer Umberger, Jr.
Keith Alexander Upchurch
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Robert Burton Warren
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Sarah Melissa Wendt

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Joel Mark Harris
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Timothy William Joseph
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Murray Allen Korn
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Gerald J. Moore
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Edwin R. Niehaus, III
Roger Frederick Noble, Jr.
Olaf Herman Olsen, III
Stig Ernst Regli
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Elia John Saleeby
Paul Ruffin Scarborough
Alan David Sherwood
Bradford Lee Stevens
Robert A. Strickland
Darrell Vance Tidwell
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Robert Hughlett Townsley
Giles Wesley Vick, III
Henry Cephas Walters, Jr.
Gerald Russell Whitt
David Michael Word

Bachelor of Science in Nursing

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Joan Della Arnold
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Nancy Louise Beetham
Mary Augusta Bigelow
Barbara Ann Borshay
Patricia Louise Briggs
Suzanne Elizabeth Brittingham
Sandra Mae Budner
Meredith Louise Burke
Diane Burn
Carolyn Ann Bythewood
Anne Betts Carpenter
Erica Ann Caruso
Lizabeth Ann Chockley
Jean Ann Colgan
Brenda Nevidjon Corley
Juliet Elizabeth Crennel
Deborah Ann Crum
Jeana Glenn Davison
Deborah Dénise Dickerson
Susan Elizabeth Dye
Jane Ellen Ehrensall
Barbara Ann Eshelman
Janet Finklea
Jean Marie Francis
Katherine Ann Gracely
Ruthanne Lamb Green
Marsha Lynne Hallman
Judy Jean Hamburg
Deborah Ann Handrahan
Gayle Markeitha Bridges Harris
Barbara Susan Hopkins
Cathy Jo Whitley Horton
Sandra Marie Hower
Linda Carol Hurst
Sue Ella Iddings
Kathryn Jeanne Jaquette
Dora Jane Johnston
Jacquelyn Marie Engelien Kelley
Margaret Ann Lammert
Daryl Louise Maass
Anita Ragna Madea
Jane Mandeville
Kathy McCormick
Cheryl Ann Noncarrow
Suzanne Speiser Orkin
Janice Carol Orman
Candace Brooke Otte
Margaret Ann Page
Holly Ann Palmer
Rita Gemma Parrell
Katherine Sue Peck
Deborah Nowack Prim
Martha Jane Reese
Jane Ellen Rippe
Barbara Keet Sabin
Joyce Elizabeth Slusher
Diane Marie Smith
Ellen Gray Smith
Sallie Louise Smith
Beverly Frantz Springer
Jane Elizabeth Stallard
Kathi Stertzbach
Georgia Linton Stevens
Constance Ingrid Stevenson
Lou Anne Summers
Angela Turner Supplee
Carol Hancock Taaffe
Margaret Godfrey Thompson
Sheila Marie Watkins
Valerie Ellen Wenzel
Athanasia Maria Williams
Deborah Camille Williamson
Elizabeth Bryan Willis
Deborah Frances Wright
Kathy Anne Zinsmeister

HONORS AND DISTINCTIONS OF CANDIDATES FOR DEGREES, 1972

The Woman's College and Trinity College

Summa cum laude

Robert Lowe Byrd
David Arthur Brodsky
Scott Russel VandenBerg
Sue Ensor Behringer
Chrysee Lynn Kline
Robert Burton Warren
Ann Williams Lane
Catherine Joyce Everett
Joanna Garber Wappler
Janet Louise Young
Sidney Loy Gulledge, III
Annette Dixon
Jean Paris Taylor
Marjorie Susan Axelrod
Lonnie Ray Sherrod
Mary Frances Burt
Marie Elisabeth Katz Brodsky
Mary Jean Brady
John Stephen Lawrence, Jr.
Paul Ray Lambert
George Karl Rahdert
Sarah Marshall Ellett
Sara Estes Brown
Cathleen Dru Cake
Miguel Levy
Stephen Dockler Holmes
Charlotte Burton Adams
Lawrence Bruin Katz
John Charles Beall
Brad Leslie Doores
John Aubrey Howell
Peter Wallace Steele
Joan I. Fiore
Bruce Alan Perler
Jeffery Harris Sheetz
Frederic Dean Fravel

Magna cum laude

James Ragan Gosey, Jr.
Elsa Ruth Hirvela
Scott Etheridge Maxwell
Susan Elizabeth Darrow
Fredrika Horton Quinn
Karen L. Laughlin
Gano Tschudy
David Eric Carpenter
William David Cochran
Ann Margaret Wightman
Anna Mary Wessinger
Mary Elizabeth Renaud
Hendey Hostetter
Lawrence Eley Blanchard, III
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Jerome Charles Katz
AmyJo Frank
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Craig Randall Irish
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Patricia Jean Lamkin
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Michael Paul Vincent
Steven Hubrig Koehler
Christy Jones
Kathryn Ann Lynn
Timothy Scott Yocum
Gregg Allen Friedman
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Joe Willingham Russell, Jr.
Steven Lamar Woodall
Klobia Gunter Spencer
Nikita Laureano Harwich Vallenilla
Michele Elisabeth Faber
Carol Ann Friedenberg
Barbara Laine Blaylock
Robert Arnett Shaw
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Charles Brad Jenkins
Margaret Irwin Leggett
Elizabeth Prue Turbyfill
John Lawrence Campbell
Thomas Joseph Kosnik
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Karen Ann Sindelar
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John Durward Holly, III
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Jeffrey Warwick Gold
Karen Ruth Bird
Sandra L. Zeese
William Bruce Plotkin
Scott William Salon
Teddi Ann Schlossman
Richard Alan Bruno
John Andrew Kindzierski
Charles Lee
Bryan Paul Simmons
Marie Marshall Fortune
Virginia Carol Perkerson
Brenda Sue White
Margaret Ruth Bolick
William Bruce Weaver
Corinne F. Travillion
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Melinda Anne Agsten
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Sarah Melissa Wendt
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Lydia Anna Rainey
E. Gregory Cehan
Margery Sue Silverton
David Alexander Wilson
John Dunbar Orr
Marcella Nadine McCrary
Dayna Grant
Lewis Allen Grabow
Diana Esther Wheeler
Mary Sue George
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John Philip Kreager
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Robert Graham Martz
Patricia Ann Parmly Rossiter
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Cecile Catherine Usdin
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John Franklin Daugherty
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Ralph Landis Engle, III
Gregory Allan Kern
Candace Irene Chandler
Stuart Carlton Lilly
Ronald Gibson Burns
Kirkwood Floyd Adams, Jr.
Marie Susan Tomlinson
Pamela Carroll Beam

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DEPARTMENTAL GRADUATION WITH DISTINCTION

Botany

Paul Anthony Armond, Jr.
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Chemistry

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Michael Edward Childs
Kenneth Marvel Gordon
Joel Mark Harris
Curtis R. Miles
John Parkinson
Matilda Perkins
John Joseph Rynasiewicz
Peter Wallace Steele
Gary Miles Townsend

Economics

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Michael Kevin Kennedy
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David Newell Wallingford
Jennifer Lynn Warlick
David Alexander Wilson

Electrical Engineering

Edward George Buckley
Leonard Zigmond May
Frank P. Tomczyk

Mechanical Engineering

Paul Stoner Follansbee
Ronald Edwin Heimann
Paul R. Scarborough

English

Karen L. Laughlin

History

Nikita Laureano Harwich Vallenilla
Gregory Allan Kern
Manuel H. Savatgy
Francisco A. Scarano-Fiol
John Bartley Schmitt

Music

Jon Proctor Ward
Maurice Willis Wright

Philosophy

Charles Richard Morgan

Physics

William David Cochran
David Alfred Hardy
Stephen Dockler Holmes
Miguel Levy

Political Science

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John Lawrence Campbell
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Charles Terry Hall
Christopher Brecht Hanback
John Stephen Lawrence, Jr.
Claron A. Robertson, III

Psychology

Judy K. Brunso
Lawrence Bruin Katz
Margaret Irwin Leggett
Douglas Lewis Massingill
Scott Etheridge Maxwell
Mark Byron Olinger
Michael Harvey Rivner
Joan Priscilla Stephenson
Franklin P. Whitley, III
Paul W. Zarutskie

Romance Languages

Robert Gordon Atcheson
Stephen M. Emerson

Zoology

Robert Carroll Allen
Wynn Randy Schwartz
Lonnie Ray Sherrod
Scott Russel VandenBerg

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Barnette Coley Crabtree
Mark Byron Olinger

SCHOOL OF ENGINEERING

Summa cum laude

Gerald Russell Whitt
Leonard Zigmond May

Magna cum laude

Stephen D. McCullers
Paul Ruffin Scarborough
Paul Stoner Follansbee
Paul Little, III
Ronald Edwin Heimann
Giles Wesley Vick, III
William Donald Needham
George David Graham
Charles Joseph Coates

Elections to Tau Beta Pi

Charles Joseph Coates
Paul Stoner Follansbee
Ronald Edwin Heimann
Leonard Zigmond May
Stephen D. McCullers
William Donald Needham
Paul Ruffin Scarborough
Giles Wesley Vick, III
Gerald Russell Whitt

SCHOOL OF NURSING

Summa cum laude

Sue Ella Iddings

Magna cum laude

Georgia Linton Stevens
Erica Ann Caruso
Holly Ann Palmer
Susan Elizabeth Dye
Jean Ann Colgan
Janet Finklea
Brenda Nevidjon Corley
Margaret Ann Page
Anne Betts Carpenter
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Robert Eugene McKeown
William Martin Finnin, Jr.
John Christian Wilson
John Bradley White
Woodrow Wilson Wells, Jr.

Magna cum laude

Albert Lucien Bergeron
John Wesley Rast
Cecil George Fulmer
Frank Joseph Stalfa, Jr.
Paul Carlton Field
Stephen Collinson Gray
Roy Everette Lenox, Jr.
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James Evans Douthat
Thomas J. Nolan
Phillip Royce Emerson
William Mark Craig
Cecil Gene Jester

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Milo Brown
Mary Frances Burt
Robert Lowe Byrd
Cathleen Dru Cake
David Eric Carpenter
William David Cochran
James Harbin Cooke, Jr.
Susan Elizabeth Darrow
Kathleen Marshall Dellastatious
Annette Dixon
Brad Leslie Doores
Sarah Marshall Ellett
Sue Ann Ensor
Catherine Joyce Everett
Joan Immaculate Fiore
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AmyJo Frank
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Kenneth Albert Gabard
James Ragan Gosey
Sidney Loy Gulledge, III
William Harris
Elsa Ruth Hirvela
Stephen Holmes
Hendy Hostetter
John Aubrey Howell
Craig Randall Irish
Christy Jones
Stella Parker Jones
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Lawrence Bruin Katz
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Steven Koehler
Charles Morton Lakin
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Kathryn Ann Lynn

Scott Etheridge Maxwell
Leonard Zigmond May
Stephen Dale McCullers
Thomas Dixon McKnight
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Bruce Alan Perler
Mark Lewis Perlman
Fredrika Horton Quinn
George Karl Rahdert
Annmarie Rehm
Mary Elizabeth Renaud
Joe Willingham Russell, Jr.
Paul Ruffin Scarborough
Teddi Schlossman
Richard Lee Scott
Michael Seitzinger
Robert Arnett Shaw
Jeffrey Harris Sheetz
Lonnie Ray Sherrod
Peter Wallace Steele
Susan Winifred Stiles
Jean Paris Taylor
Gano Tschudy
Scott Russel VandenBerg
Michael Vincent
Joanna Wappler
Robert Burton Warren
Eric Weidmann
Anna Mary Wessinger
Gerald Russell Whitt
Ann Margaret Wightman
Maurice Wright
Janet Louise Young

SPECIAL PRIZES AND AWARDS

ACC Plaque for Excellence in Scholarship and Athletics—Louis Richard Lothman
American Society of Civil Engineers Prize—Tedd Hunter Jett, John Nathaniel Crowder, Jr.
American Public Works Association Prize—Stephen D. McCullers
Alice M. Baldwin Scholarship Award—Robin E. Bounous, Marie Elisabeth Katz Brodsky, Catherine Joyce Everett, Elsa Ruth Hirvela, Hendey Hostetter, Sarah Elizabeth Scott
Evelyn Barnes Memorial Scholarship—Jon Proctor Ward
Davison Scholarship—Nancy Mae Welch
Delta Delta Delta Scholarship—Sue Ella Iddings
Duke University of Chemistry Award—Joel Mark Harris
Anne Flexner Memorial Award for Creative Writing—Second Prize—Stephen M. Emerson, Third Prize—Samuel Williams Earle, IV
Edward C. Horn Memorial Prize in Zoology—Scott Russel VandenBerg
Lange Medical Publications—Joseph Michael James Corless, Jeffrey Wellington Wilson
Robert E. Lee Award—Louis Richard Lothman
Merck Index Award—Sidney Loy Gulledge, III
Milmow Prize—Leonard Zigmond May
C. V. Mosby Book Award—John Charles Alexander, Jr., Dana Kimball Andersen, David Ross Garr, Terry L. Hankey, Morton Hill Levitt, Mona Marlynn Shangold, David Kenton Wellman
Moseley Award—Sue Ella Iddings
School of Nursing Alumnae Award—Marsha Lynne Hallman
James Oliver Memorial Prize—Larry Fredrick Bassman
Outstanding Service Award—Deborah Camille Williamson
Roche Award—John Elmore Lawrence, Jr.
Henry Schuman Prize for Music—Maurice Willis Wright
Charles Ernest Seager Memorial Award—Frank Paul Tomczyk
Walter J. Seeley Scholastic Excellence Award—Gerald Russell Whitt
William Senhauser Prize—James Daniel Kirk
George Sherrerd III Memorial Award in Electrical Engineering—Gerald Russell Whitt

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Walter J. DeWinter
Gary H. Duncan

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Alegria Esther Freedman
Lillian Gray Gregory
Seth Grossman
Heloise Catherine Merrill Heath
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Frances Susan Whitted
Sandra Bubas Yarbrough

BACHELOR OF SCIENCE

Malvin Proctor Barnes
Herbert E. Lehman
Edward Leigh Walter

BACHELOR OF SCIENCE IN ENGINEERING

Ted K. Field

COMMISSIONED OFFICERS IN THE UNITED STATES NAVY AND THE UNITED STATES MARINE CORPS

Ensign, United States Navy

Robert Edward Ansley, Jr.
David Hughes Barber
John Samuel Elliker, Jr.
James LeGrand Everett, IV
Joseph A Harland
Peter Lawrence Hilbig
Robert Bruce Johnson, II
Stuart Carlton Lilly
William Donald Needham
Howard Vernon Richardson, III
Charles Cass Simpson, III
Janvier King Smith
Peter Wallace Steele
Nicholas Jon Tennyson
Michael Paul Vincent
William Alan Young

Ensign, United States Naval Reserve

John Aubrey Howell
Lee Kearsley Williams
Frederick Calhoun Wyse

Second Lieutenant, United States Marine Corps Reserve

Paul Marshall Stouffer

COMMISSIONED OFFICERS, UNITED STATES AIR FORCE

Second Lieutenant, United States Air Force Reserve

Milo Cully Brown
John Lawrence Campbell
Barnette Coley Crabtree
Gregory Gilbert Drutchas
Kenneth Durwood Gailey
David Alfred Hardy

John David Kirkland
John Richard Leighton
Robert John Lynch
Curtis Richard Miles
Mark Byron Olinger
Craig Williams Rice
Michael Leigh Shortridge
Gordon McIntyre Stevenson
Elia John Saleeby
Robert Trexler Taylor
Tommy Joe Williams

WOMAN'S COLLEGE

Freshman Class Honors, 1971-72

Peggy S. Lindsey
Barbara J. McCown
Ellen A. Thalmann
Wendy L. Marshall
Sue B. Hicks
Teresa L. Gholston
Linda C. Graef
Virginia C. Broaddus
Kathleen M. Ryan
Barbara J. Buchholz
Robin A. Ferracone
Margaret A. Hassett
Rita A. Muessel
Laura W. Morgan
Deborah E. Horton
Janet A. Seiz
Susette K. Smith
Mayling C. Blanco
Kristine E. Freeark
Lisa Kaufmann
Nancy Noechel
Cheryl A. Kessler
Sarah A. Faulkner
Susan J. Dubois
Cynthia S. Salley
Betsy E. Walker
Gale M. O'Donnell
Judith M. Lyman
Donna M. Atwood
Janice Trawick
Ann L. Schreiber
Marion Applegate
Donna G. Hurlock
Valerie A. Robison
Karen L. Roberts
Kristen L. King
Julie E. Reeder
Linda R. Welder
Cynthia S. Stautberg
Janette M. Stanford
Holly B. Brubach
Deborah L. Byrd
Martha J. Barnholdt
Jacqueline McKinney
Maria C. Lamadriz
Daren G. Cloninger
Christine D. Swafford
Lydia H. Vollmer
Arlene L. Bender
Doranne E. Meny
Mary E. Meyers
Nancy J. Muller
Cynthia A. Roberts
Patricia A. Karatsis
Bonnie J. Terardi
Joy C. Charlton
Vera-Ellen Bernard
Christine L. Graham
Jean B. Symington
Suanne I. Wright
Marie C. Swift
Sharon E. Edwards
Leecy A. Barnett
Jane M. Alexander
Barabara L. Locastro
Harriet S. Hopkins
Marilyn Hamilton
Marilynn A. Prince
Allison J. Krahling
Cameron L. Kelly
Paula N. Ecklund
Marsha G. Adams
Linda K. Levin
Sara D. Hoyt
Ellen D. McLean
Ellen L. Brandenburg
Elizabeth A. Lunbeck
Michele C. Pusey
Melinda E. Millar
Ricarda B. Berry
Elizabeth W. Cecelski
Linda J. Grover
Marsha M. McGraw
Lee N. Walker
Janice N. Furlong
Deborah L. Fisher
Cheryl L. Fuller
Mary E. Dobson
Louisa D. Stiles
Nancy L. Milner
Susan L. Patterson
Paula L. Schwartz
Janet M. Doss
Holly A. Elmendorf
Claudine L. Segerlind
Susan L. Watts
Michelle M. Shavel
Patricia A. Cole
Cynthia C. Hartwig
Lynn A. Vanderwist
Charlene D. Legrand
Lucy A. Mott
Carolyn A. Conley
Myla A. Taylor

Constance L. Speidel
Sheilah A. Bernard
Constance L. Cummins
Margot A. Trusty
Carole A. Yarbenet
Ann G. Applegate
Elizabeth A. Hedrick
Diane Patrice Jaust
Katherine E. Holloway
Geri L. Haney
Maria A. Cook
Margaret H. Caldwell
Carol L. McVane
Evelyn H. Wright
Eleanor F. Thompson

Sophomore Class Honors 1971-72

Emily R. Lutken
Patricia C. Ward
Susan T. Andrews
Elizabeth L. Sears
Beverley H. Means
Janet O. Kilby
Barbara A. Trimble
Margaret S. Allison
Anne R. Edwards
Christina Hall
Ellen M. Thompson
Linda L. Macht
Virginia F. White
Sarah I. Williams
Doren L. Madey
Lida R. Hall
Pamela Cotton
Wendy A. Keitel
Ellen E. Wright
Deborah Groves
Marsha L. Van Lawick
Louisa B. Plyler
Katherine Townsend
Gail L. Unterberger
Helen A. Smith
Teresa H. Martin
Julie E. Blume
Rebecca A. Dull
Louise L. Martorelli
Gale E. Rasin
Jennifer E. Taylor
Linda A. Usdin
Kathleen M. Hanigan
Nancy Knight Duggins
Joan B. Golden
Caroline L. Cook
Katherine P. Lockhart
Barbara L. Gregory
Deborah K. Roberts
Bonnie K. Parr
Louise G. Upchurch
Diana R. Silimperi
Cynthia Pauley
Susan M. Matamoros
Katherine H. Lamb
Wendy K. Miller
Margaret L. Norsworthy
Joan L. Cobb
Martha A. Shindelman
Susan L. Willey
Nora Gunneng
Barbara K. Fite
Melissa J. Eddy
Sharon E. Wells
Georgia Ann McElroy
Cheryl A. Rouge
Alive L. Kirkman
Christine A. Schoenberg
Joanne C. Shepherd
Susan A. Jones
Marci J. Kramish
Barbara A. Lapp
Lise C. Howe
Sharon J. Darragh
Diane L. Appleton
Ann L. Avery
Sharon L. McCrary
Rachel L. Steele
Catherine Blue
Sue Anne Eichhoff
Susan B. Bastress
Karen L. Cato
Gail D. Goundry
Marcia L. Rementer
Margaret L. Deuel
Jo A. Farrington
Sarah E. Moran
Deborah H. Smith
Mary M. Glennon
Susan Haltiwanger
Phyllis A. DeCarlo
Janet R. Beck
Patricia A. Gaedeke
Pamela Gensler
Jean E. Haworth
Susan L. Fetter
Susan L. Wolff
Laurie Ivins
Jane W. Patrick
Katherine L. Bishop
Robin L. Schnitzer
Lisa Linkhaw
Linda L. Erwin
Allison A. Blount
Mignon Durham
Julia E. McMurray
Dianne M. Jardno
Jeanne E. Beers
Anne D. Alexander
Julie D. Thorne
Denise A. Mummert
Karen Lea Coy
Susan R. Baker
Katherine A. Twomble
Sara K. Sudduth
Amy D. Hogue
Kerrie L. Protsman
Anna B. Payne
Paula B. Newman

Judith A. Migliori
Lynn P. Mathieu

Junior Class Honors 1971-72

Eugenia C. Delamotte
Edith M. Murphy
Judy D. Brinson
Ann C. Dean
Ida M. Thomas
Mary J. Brady
Susan Elizabeth Walker
Joan A. O'Connor
Cathy E. Krug
Carol A. Herron
Teresa K. Galloway
Mary J. Rushing
Paulette K. Arnold
Nancy G. Johnson
Deborah Lyndall Smith
Frances S. Marocchi
Kathleen M. Bailey
Nanette H. Bishopric
Katharine D. Kennedy
Shelley June Hanson
Sheryl A. Pastryk
Billye L. Higdon
Diane C. Touret
Pamela M. Chin
Alice M. Taylor
Frances R. White-Spunner
Alexa A. Kampson
Leigh E. Wenzinger
Gael Marshall
Nancy Shayne Weigle
Elizabeth A. Dupree
Ann F. Rosenberg
Susan S. Smith
Susan H. McDaniel
Cynthia A. DeFrance
Helen H. Hand
Margaret G. Williams
Priscilla C. Jack
Lucia A. Ward
Kathleen Morgan Kirkman
Ruth E. Partin
Diane Mahony
Gail P. McConnel
Virginia A. Dunkley
Kathryn A. Braun
Carol A. Winterton
Laura S. Forgeron
Martha E. Manuel
Debra J. Long
Kathryn A. Browne
Allison D. Dickson
Anne A. Eldridge
Sarah M. Wendt
Eleanor C. Burke
Linda T. McMillan
Mary L. Foster
Deborah F. Hotch
Margaret A. Thomas
Linda Carol Smith
Patricia L. Kellett
Melissa E. McMorries
Suzanne E. Miiller
Amanda J. Mathis
Holly S. Chambers
Beverly V. Meyer
Emily M. Sadler
Janice L. Moore
Janet L. Krahler
Amarette Hill Gery
Nan L. Coleman
Carolyn A. Cook
Alice J. Bassman
Catherine A. Perillo
Carol S. Disque
Jayne M. Booker
Ellen F. Hanna
Ruth C. Ange
Celia Lee Allman
Sallie A. Moore
Marianne Jackson
Linda L. Parker
Lynne D. Platt
Karen L. Stafford
Donna J. Early
Suzanne E. Braley
Janice C. Boon
Cheryl Ann Pitts
Deborah S. Ketcham
Barbara L. Smith
Barbara C. Shelhoss
Alice L. Lee
Dara L. Dehaven
Kathy L. Summerlee
Carolyn Annette Prescott
Margaret A. O'Connell
Ruddy Michele
Michele Nathan
Linda Jean Barlow
Pamela W. Armstrong
Joy P. Latimer
Marilyn A. Koch
Sally Louise Campbell
Susan V. Whitlock
Maureen E. Smithwick
Karen A. Colwell
Dianna G. Jones
Doreen L. Hughes
Diane W. McMahon
Barbara J. Boone
Nancy C. Bradley
Sandra J. Ambrose
Frances K. Greenberg
Jude A. Cassidy
Anne P. Mercer
Mary L. Johnston
Karen M. Reimann
Sally A. Roffman
Karen J. Gullberg

TRINITY COLLEGE

Freshman Class Honors, 1971-72

Andrew J. Weinheimer
Joseph L. Lineberry, Jr.
Rick K. St. Pierre
Jeffrey J. Guyon
Charles D. Wingate
Marshall E. McCabe, III
Vincent J. Egizi, Jr.
Juan R. De Armendi
Douglas S. Reintgen
Robert W. Paterson
William C. Sando
Frank R. Brown, Jr.
Timothy M. Sublette
James W. Young
George R. Wagoner, Jr.
John A. Kreutzer
James E. Lee
Richard P. Roelofs
Edwin P. Bounous, Jr.
Richard B. Abriss
Stuart I. Harris
Robert L. Bender, II
Barry W. Lee
Jonathan M. Silver
David T. Rudnick
Martin M. Klapheke
Charles M. King
Mark B. Ballard
Daniel E. Everitt
Charles R. Turner
Jeffrey D. Blass
Thomas J. Parker
Richard W. Scott
Rudy M. Baum
Daniel G. Marshburn
William H. Jefferis
William L. McCarty
Cecil J. Holliman
John B. Strott
Peter A. Graybill
Mark T. Wilson
Thomas E. Metcalf
Bruce R. Weinstein
Richard Q. Block
Gregory A. Robertson
Robert S. Porter
Robert W. Myatt, Jr.
William G. Carpenter
Mark A. Helvie
Stephen A. Yoder
Peter K. Zirkle
Carlos Enrique Grave De Peralta
Michael E. Dresser
Jeffrey L. Hunter
Philip J. Butera
Michael J. Carney
John A. Barnet, III
Albert A. Barrows, III
David W. Ichel
Timothy P. Denny
William M. Vincent
Carl A. Patow
David T. Rice
Tom A. Ranseen
Kevin A. Somerville
David C. Dressler, Jr.
Bruce E. Hutson
Eric H. Loevinger
Zebulon L. Bowman
William M. McDonald
Andrew B. Littman
John E. Burgess
Joel S. Goldberg
David L. Ness
George C. Newby
Michael G. Reiland
Thomas B. Prebble
George W. Dameron
Thomas L. Beardsley
Barron P. McCune
Richard A. Mathe
Louis P. Tychonievich
Robert S. Turner
David R. Dehass, Jr.
Stephen W. Schaaf
Gerald A. Regan
Steven C. Kirk
James N. Gerhard
Gregory N. Smith
David B. Rubin
James B. Simpson
Richard N. Franklin
Steven Garland
Alan D. Fix
Garry R. Walker
Harold A. Weaver, Jr.
Henry P. Frieder
Edward S. Stanton
Richard C. Newsham, II
David M. English
Walter L. Mullen
Leigh D. Quarles, Jr.
Clifford E. Felder
David B. Tanenbaum
John C. Jackson
Steven H. Baker
Thomas T. Smirniotopoulos
Mark E. Bonds
John W. Heath, Jr.
Robert S. Fox
Gary S. Jacobs
Raymond Mayron
William A. Anderson
Michael R. Gorman
Robert S. Gross
Steven L. Haughton
Reginald J. Clark
Edward W. Mullinix, Jr.
Thomas T. Noland, Jr.
John A. Stevenson

Ralph E. Whatley, III
Leonard S. Wojnowich
Chris E. Blodi
G. Randall Avery
Harris M. Allen, Jr.
Jonathan J. Weiner
James O. McIntosh
Stephen A. Levin
Scott S. Oren
Robert S. Watkins
Robert S. Truesdale
Richard A. Allnutt, III
Michael L. Berman
James M. Douglas, Jr.
Thomas R. Truscott
Finis E. Williams, Jr.
Jonathan P. Weston
Ray B. Duggins, Jr.
Jerrold M. Filipski
William S. Ashley
James R. Schroll
Robert L. Atchison
Stuart L. Dean
Harvey C. Foushee, Jr.
Richard Meshulam
William S. Leatherman
Harry M. Herman, III
Donald E. Parrish
Kenneth B. Rhinehart
Kenneth E. Pogash
Kenneth S. Hoyle
James L. Mohler
Paul W. Schach
Stanley G. Brading, Jr.
James S. Bain
Lawrence G. McMichael
Kurt A. McKissick
Mark B. Meyers
Michael L. Jones
Lee S. Dennison
George F. Woelfel
Jesse W. St. Clair, III
William H. Creed, Jr.
Warren N. Eggleston, Jr.
Alan R. Saltiel
Ezra D. Margolis
Michael A. McCauley
J. K. Buster
Randall B. Boggs
Douglas P. Kiel
Leslie C. Moye
John E. Harris, III
Bryan L. Smith
Robert K. Tatum
Bruce S. Babski, Jr.
Charles W. Cunningham
Julian F. Keith, III
Douglas C. Wolf
Neale A. Cogswell
Robert Arasi
Don J. Gentile
Clarence James Gideon, Jr.
Joel G. Kingsolver
Steven P. Gellman

Sophomore Class Honors, 1971-72

Randall C. Richard
Jarvis Dean Brock
Steven M. Klebanoff
Morgan P. Meyer
Richard E. Smitherman
Bruce Trowbridge
Barry E. Wind
John K. Gibbons
Michael L. Cooper
David E. Robinson
Richard Painter Shryock
John E. Gent
John C. Wood
James M. Horton
Stephen W. Brewer
Charles M. Vanderhorst
Steven R. Savona
Warren W. Olds
Ronald Rovner
James M. Iseman, Jr.
Nels R. Leininger
James R. Eskew
Richard C. Sutoon
Bruce R. Genderson
David W. Hannon
Charles E. Mortensen
Edward S. Lauer
Clifford D. Goalstone
Stephen A. Wank
David S. Boger
Orvey P. Lowrey, III
Richmond L. Blackstone, Jr.
Robert C. Barrett
Joseph G. Varnadore
Nathan Lee Dodson
Joseph A. Boone
Steven F. Roark
Michael T. Hippler
David Clarence Morris
Roddey Reid, III
Walter R. Rogers, Jr.
James M. Avent
Orville R. Surla
James D. Winthrop
Daniel A. Rogers
David C. Crago
Charles H. Dearborn, III
Robert N. Knight, Jr.
William R. Clarke
James G. Philipson
William C. St. Amant
Lance E. Tunick
Jerry S. Apple
Jesse M. Colvin
Michael C. Nolan
Dana S. Pfaff
William M. Rogers, II
Richard Ravits
Lawrence J. Ryan
Melville S. Brown

Bruce A. Moyer
Gordon E. Stanley
James S. Beck, III
William L. Ferber
Richard J. Welch
Donald F. Hull, III
John W. Hutchinson
Shawn L. Kelly
Patrick T. Crane
John B. Shepherd, Jr.
Walter A. Record, III
Stephen Ian Reinstein
Thorton S. Smith
Daniel P. McMahon
Richard T. Hurt
Larry J. Morell
Robert F. Bencze
James A. Grasso, Jr.
Adour G. Adrouny
Herbert C. Rubright, Jr.
Lawrence M. Jones
Philip A. Disque
Justin T. Roscoe
Victor B. Shelburne, III
Alfred O. Peeler
Joseph O. Gehrett, Jr.
John W. Clower
Albert J. Novak, Jr.
Jim H. McNatt
Thomas B. Weaver
Kenneth P. Kirk
Arthur G. Holder
Eric P. Weitz
Jeffrey C. Tyler
Thomas E. Dittmar
Jon J. Harrison
Charles G. Cofer
Peter H. Dygert
Wayne R. Kempson
Anton P. Nielsen
Roberdeau Dunn Simmons
Paul M. Smolen
Thomas W. Robisheaux
David B. Stein
Robert B. Euler
Robert R. Kuehn
Robert W. Johnston
Richard S. Cooper
Richard J. Fildes
John S. Hahn
Kenneth L. Peoples
Mark C. Walker
Timothy C. Wilcosky
Kenneth A. Shifrin
Bruce E. Blevins
Kenneth W. Blumenthal
Thaddeus L. Dunn
Charles P. Ellington, Jr.
William D. Brantley
Michael S. Baker
Malcolm L. Chaney
Donald M. Etheridge, Jr.
Frank J. Gadusek
Robert S. Parker
Adam Sternberg
John H. Leavens
Paul N. Rudolph
Samuel A. Owen, Jr.
Douglas E. Glenn
Wayne L. Harper
Mark A. Benedict
Kurt L. Gandenberger
Clifford H. Nelson, Jr.
Madison S. Spach, Jr.
Robert A. Jaworowski
James W. Wicker, Jr.
Luther C. Copeland, Jr.
Richard A. Melcher
Kenneth A. Black
Randall W. Atkins
Thomas G. Hoffman
Charles V. Phillips, III
Meredith S. Senter, Jr.
John M. Berry
Brian R. Delong
Christopher B. Graybill
Stephen M. Todd
David L. Ross
Paul L. Wischow
Eric F. Ensor
Robert Bruce Johnson
James L. Morris
Robert S. Tate
Timothy S. Chappars
Stephen G. Melcer
Edward P. McNamara
Bruce M. Albert
Burton C. Conner
Michael A. Musselwhite
Ronald E. Barab
John M. Alton
Jeffrey M. Graves
Lee G. Gersch
Nill V. Toulme
Shane J. Kraus
Joel J. Lerner
Robert S. McDuffie, Jr.
Paul J. Mass
Gary A. Manko
Cris W. Jacobs
Daniel M. Greenberg
James A. Cutrara
William H. Pauley, III
David M. Eisenberg
Kim A. Carmichael
John E. Dewar, II
Jeffrey L. White
P. Thomas Hirsch
Dennis Richard LaFiura

Junior Class Honors, 1971-72

Mark E. Stalnecker
Mark J. Gotay
Joseph M. Thomas
John D. Kennedy, Jr.
Thomas J. Baden

Charles R. Beaudrot
Peter Van Trigt, III
Jan T. Hall
Jeffrey Clark Smith
Thomas H. O'Hare
Robert Brian Rice
Milton M. Wachsberg
Marshall C. Mintz
James T. Parsons
David D. Parr
Joseph C. Bosch
Waldo E. Martin, Jr.
David G. Luther, Jr.
Thomas P. Foy
Michael W. Decker
Henry M. Beck, Jr.
Mark W. Denny
Mark S. Gorovoy
Ben H. Logan, III
Rudolph C. Schweizer
David A. Schoenholz
James L. Stiepan
Harmon M. Pyles
John C. Platt
Mark S. Nielsen
William H. Callaway, Jr.
Robert A. Wason, IV
Ronald S. Gass
Andrew W. Elder
Richard L. Epling
Robert M. Califf
Stephen E. Bear
Glenn R. Reichardt
Curtis L. Reynolds, III
William Kress Schapiro
Terry G. P. Kane
Jeffrey J. Davidson
Peter A. McCue
Edward M. Hanson, Jr.
Scott B. Sherman
Eric R. Galton
Peter M. Kareiva
Raymond D. Kiser
William J. McEvoy
James K. Bradley
Robert J. Zeller
Timothy Wayne Terry
Robert H. Brinkmeyer, Jr.
Robert A. Worster
Paul W. Zarutskie
Karl C. Saunders
Mitchel A. Kanter
John M. Williams
Kenneth F. Trofatter, Jr.
Roger E. Carp
John B. Gontrum
Gregg H. Jones
Barry D. Hoberman
Tim D. Grotts
Bobby MacBryan Green
Scott B. Bullock
Douglas A. Chapman
Peter E. Broadbent, Jr.
Norman A. Varney
James C. Yardley
William J. Stanhope
Paul G. Saunders, II
Jeffrey B. Sheldon
Charles L. Gallegos
Edward T. Walters
Dale C. Robbins
James J. Dobson
Thomas M. Brandt, Jr.
Donald R. Cassling
Christopher L. Beebe
Robert E. Stroupe, Jr.
Christopher L. Mattil
Richard J. Lynch, Jr.
Stuart L. Kutz, Jr.
Robert O. Froling, Jr.
Richard Gutierrez
Sheeley G. Coley, Jr.
Willard W. Hall, II
Jeffrey R. Means
Mitchell C. Reese
James R. Nicotera
Bruce J. Taylor
Emerson N. Gardner, Jr.
Raymond A. Frese
John A. Vernon
Stanley N. Webster
Randall B. Hudson
James F. Butler, III
Julien L. Salley
John W. M. Johnson
Mark E. Lehman
Michael E. Wilson
William C. Seefield
Michael G. Williamson
John R. Moore
Darryl K. Corriher
Andrew E. Grigsby, Jr.
James D. Moran, III
Michael S. Klein
Jay E. Mattingly
Cleveland K. Evans
George H. Pretty, II
John W. Spoganetz
James R. Dykes
James R. Bayes
Ritchie C. Shoemaker
Dale G. Davis
Richard K. Kull
Richard David Edrington
Gregory J. Moonie
John A. Miller
Steven A. Flagel
David E. Bright
Ralph L. Kugler
Paul C. Whitesides, Jr.
Seth W. Whitaker
David A. Leech
Thomas H. Oxenham, III
Craig M. Feeney
James W. Wrenn
Gard W. Otis

Robert D. Ramsey, III
Joseph G. Polanik
Dennis Yulan Washburn
Marvin E. Lymberis
Earl D. Mohr, Jr.
William H. Inman, II
Thomas P. Colantouno
Robert B. Christian
David M. Audet
Michael E. Blake
Douglas K. Eyberg
Andrew J. Decker, III
Joseph J. Czarnecki
Charles F. Ramsey, Jr.
Craig S. Shatzer
Peter Baker
Michael K. Madden
Phillip C. Wood
Robert W. Melton
Edward M. Davis
Philip R. Wisiackas
Stephen Michael Cohen
Edwin H. Page, Jr.
George K. Warren
Craig W. Dawkins
Jerrold C. Perlet
Ricardo F. Urrutia
Paul Herbert Turney
Larry Elliott Klayman
Robert L. Cook

SCHOOL OF ENGINEERING

Freshman Class Honors, 1971-72

Mark Christopher Bussmann
Dale Andrew Zolnick
Barry Glenn Shelley
David Park McCallie, Jr.
Jeffry Robert Crist
Francis Allan Moody
James Buckner Jones, Jr.
Stephen Wayne Hamilton
David Reed Markle
Paul William Gwozdz
Brian Donald Smith
Gary Douglas Shadd
William James Drummond
Braxton Henry DeGarmo
William Sater Williams
Timothy Paul McClain
John Winder B. Curtis, Jr.
Anthony Rudolph Dover
David Martyn Wheeler
Frank Wentzel Gayle
William Michael Alexander
David Wayne Markwordt
Wade Thomas Cooper, Jr.
George McNeil Lattimore
Kent Carlyle Hustvedt
Stephen Phillips Williams
Diane Merrill Davidson
Michael Lewis Halladay
Thomas Edwin Hall
David Charles Froehlich
Joseph Alan Rappazzo
Alvin Harold Shrago

Sophomore Class Honors, 1971-72

Carl Ernest Lehman, Jr.
Gary Douglas McLaughlin
Ray Lee Wooten
James Donald Klein
Michael Gary Taylor
Robert Keith Bisset
Ralph Alan Marshall
Capers Walter McDonald
Mark Warren Reinhardt
Nicholas Henry Sherman
Philip Wayne Thor
Alexander James Doyle
David Elmore Thomas
David Mark Upham

Junior Class Honors, 1971-72

Bruce Henry Battjer
Fred Mehlert Fehsenfeld, Jr.
Michael Ray Peeler
John Gary Dudley
Raymond Valdis Tiltins
James Albert Strycharz
William Madsen Kuck
Charles Lacy Ringgold
Joseph Clark Bates, III
Charlotte Jane Springer
James Joseph Gehrig, Jr.
William Tyler Perry
Nicholas Ridgely Scheller
Robert Ryoichi Ando
Charles Thomas Lunson

SCHOOL OF NURSING

Freshman Class Honors, 1971-72

Regina Boval
Lisa Ellen Flint
Catherine Lucille Reese
Alison Michelle West
Jane Margaret Woods
Caryl Lynn Zolldan

Sophomore Class Honors, 1971-72

Sandra Ann Campbell

Ellen Dee Cummings
Cynthia Irene Dahnk
Deborah Kathleen Ford
Patricia Karen Furey
Nancy Elizabeth Geiger
Gwen Francine Hegyan
Pamela Jackerson
Ann Hatcher Kirk
Nancy Lee Marville
Claudia Robertson Merritt
Deborah Hean Nearing
Sally Margaret Pekora
Rebecca Schmidt
Cynthia Jane Stoudt
Harriett Denise Watts
Laura Lynn Zelaites

Junior Class Honors, 1971-1972

Susan Elaine Akers
Barbara Ray Bordeaux
Candace Damner Chase
Janet Lemen Chesson
Kathleen Linda Davison
Gail D'Onofrio
Martha Ann Earhart
Peggy Ann Galle
Jill Naomi Giltenboth
Janet Elaine Goral
Judith Ann Gordon
Susan Catherine Hadam
Diane Lucille Holditch
Carlyn Ann Horning
Betty June Jeffcoat
Barbara Jo Kann
Kristen Ann Keirsey
Charlotte Williams Lane
Janet Thersa Matena
Jane Mullin McCormick
Marilyn McKim
Margaret Susan Meier
Elizabeth Blakey Milloy
Wendy Ann Mosher
Christine Lynette Mundie
Kathleen O'Connor
Beverly Anne Peirce
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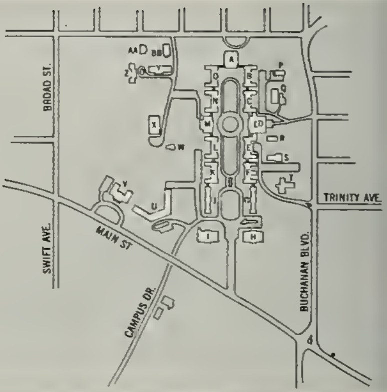
MAP OF DUKE UNIVERSITY

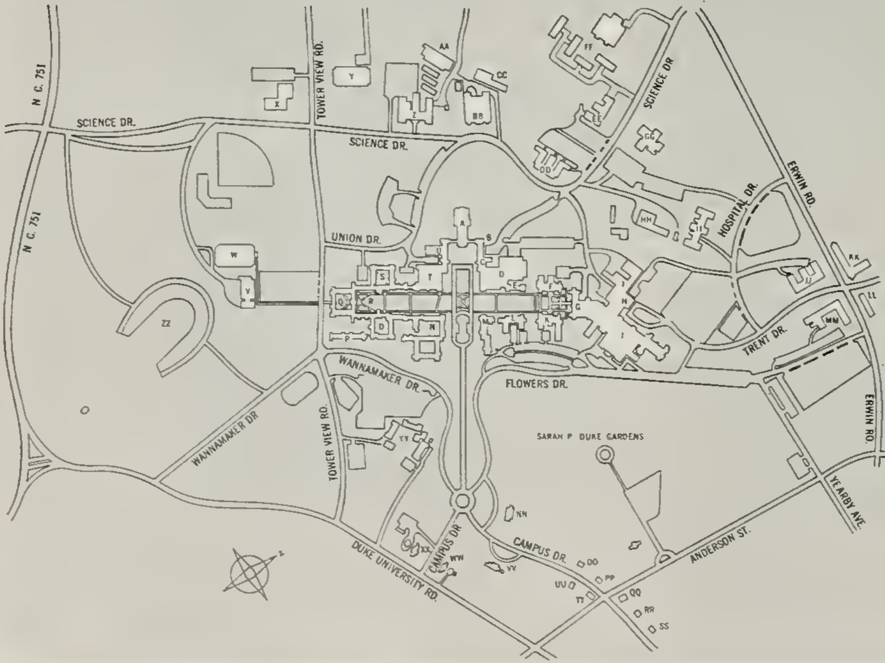
East Campus

A	Baldwin Auditorium
B	Bassett House
C	Brown House
D	Union Building
E	Faculty Apartments
F	Art Museum, Geology
G	Aycock House
H	East Duke Building
I	West Duke Building
J	Jarvis House
K	Carr Building
L	Giles House
M	Woman's College Library
N	Alspaugh House
O	Pegram House
P	Duke Press
Q	Infirmary
R	Ark
S	Crowell Building
T	Epworth Inn
U	Gilbert-Addoms House
V	Southgate Hall
W	Campus Center
X	Woman's College Gymnasium
Y	Asbury Building
Z	Bivins Building
AA	Art Building
BB	Branson Building



West Campus

A	Duke Chapel
B	Divinity School
C	Gray Building
D	Perkins Library
E	Language Center
F	Old Chemistry Building
G	Davison Building School of Medicine
H	Hospital Main Entrance
I	Gerontology, D & T, Clinical Research
J	Duke Hospital
K	Sociology, Psychology
L	Social Sciences
M	Allen Building
N	Few Quadrangle
O	Craven Quadrangle
P	Wannamaker Hall
Q	Crowell Quadrangle
R	Clock Tower Court
S	Kilgo Quadrangle
T	Union Building
U	Flowers Building Page Auditorium
V	Card Gymnasium
W	Indoor Stadium
X	School of Law
Y	Gross Chemical Laboratory
Z	Biological Sciences
AA	Plant Environment Laboratory
BB	Physics Building
CC	Nuclear Laboratory
DD	School of Engineering
EE	Army Research
FF	Medical Center Research Buildings
GG	Nanaline H. Duke Medical Sciences Building
HH	Warehouse, Shop
II	Bell Building
JJ	Hanes House School of Nursing
KK	Hanes House Annex
LL	Pickens Rehabilitation Center
MM	Graduate Center
NN	Alumni House
OO	Commonwealth-Studies Center
PP	Personnel Office
QQ	International House
RR	Personnel Office
SS	Education Improvement Program, A Better Chance Program
TT	International Studies Center
UU	Campus Stores Office
VV	Office of Institutional Advancement
WW	Information Services Visitors Bureau
XX	Admissions Office
YY	Edens Quadrangle
ZZ	Wade Stadium



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